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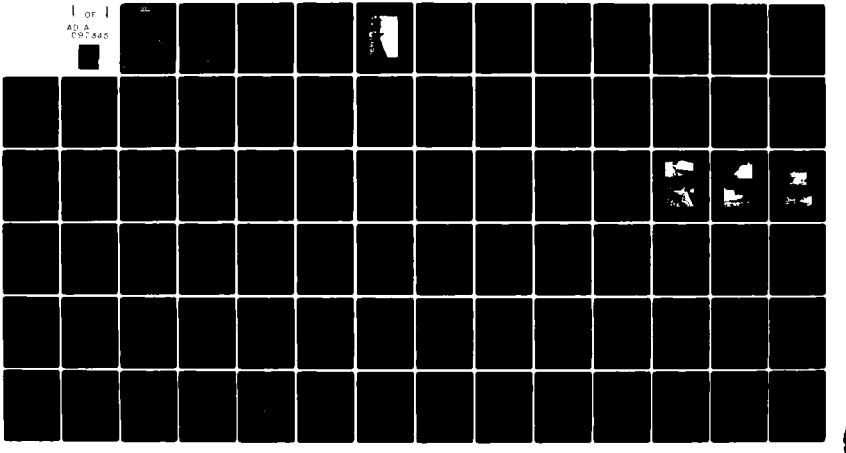

LEVEL II

(1)

AD A097345

National Dam Inspection Program

~~DELAWARE RIVER BASIN~~

LONG RUN RESERVOIR ~~NO.~~ Number 1 DAM

~~LEHIGHTON WATER AUTHORITY~~

(NDI ~~NO.~~ Number PA-00882,
DER ~~NO.~~ Number 13-004),

CARBON COUNTY, PENNSYLVANIA.

PHASE I INSPECTION REPORT,
NATIONAL DAM INSPECTION PROGRAM

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(15) DACW31-81-C-0013

PREPARED FOR

DEPARTMENT OF THE ARMY

Baltimore District, Corps of Engineers

Baltimore, Maryland 21203

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BY

Berger Associates

Harrisburg, Pennsylvania 17105

(11) FEBRUARY 1981

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PREFACE

This report has been prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITIONS AND RECOMMENDATIONS

Name of Dam: LONG RUN RESERVOIR NO. 1

State & State No.: PENNSYLVANIA, 13-004

County: CARBON

Stream: LONG RUN

Date of Inspection: October 22, 1980

Based on the visual inspection, past performance and the available engineering data, the dam and its appurtenant structures appear to be in fair condition.

In accordance with the Corps of Engineers' evaluation guidelines, the size classification of this dam is small and the hazard classification is high. These classifications indicate that the Spillway Design Flood (SDF) should be in the range of one-half the Probable Maximum Flood (PMF) to the full PMF. The recommended SDF for this structure is one-half the PMF. The spillway capacity is adequate for passing 23 percent of the PMF peak inflow without overtopping the dam. Overtopping by the SDF is expected not to cause failure of the dam. The spillway, therefore, is considered to be inadequate, but not seriously inadequate.

~~The following~~ Some recommendations ~~are~~ presented for immediate action by the owner: are:

1. That measures shall be taken to provide an adequate spillway capacity,
2. That the cracked spillway slab be repaired,
3. That the downstream end of the spillway be protected from washouts during large discharges,
4. That the upstream gates be maintained and operated on a regular basis, and
5. That the downstream blow-off valves be maintained and operated on an annual basis.

6. That the seepage be monitored on a regular basis. If turbidity or an increase in flow is detected, immediate action shall be taken to correct this condition.

7. That the slope of the embankment adjacent to the spillway be provided with a protective cover.

8. That the footbridge over the spillway be repaired.

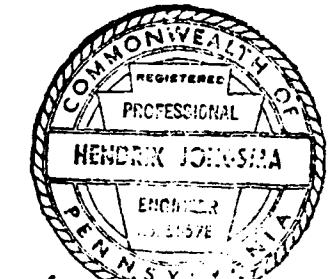
9. That a formal surveillance and downstream warning system be developed for use during periods of high or prolonged rainfall.

10. That an operation and maintenance manual be prepared for guidance in the operation of the dam during normal and emergency conditions, and that a schedule be developed for the annual inspection of the dam and its appurtenant structures.

SUBMITTED BY:

BERGER ASSOCIATES, INC.
HARRISBURG, PENNSYLVANIA

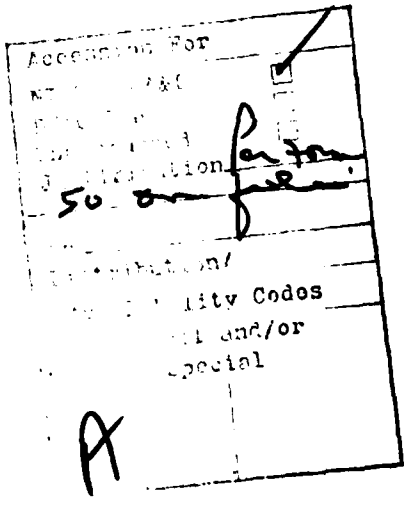
DATE: February 9, 1981

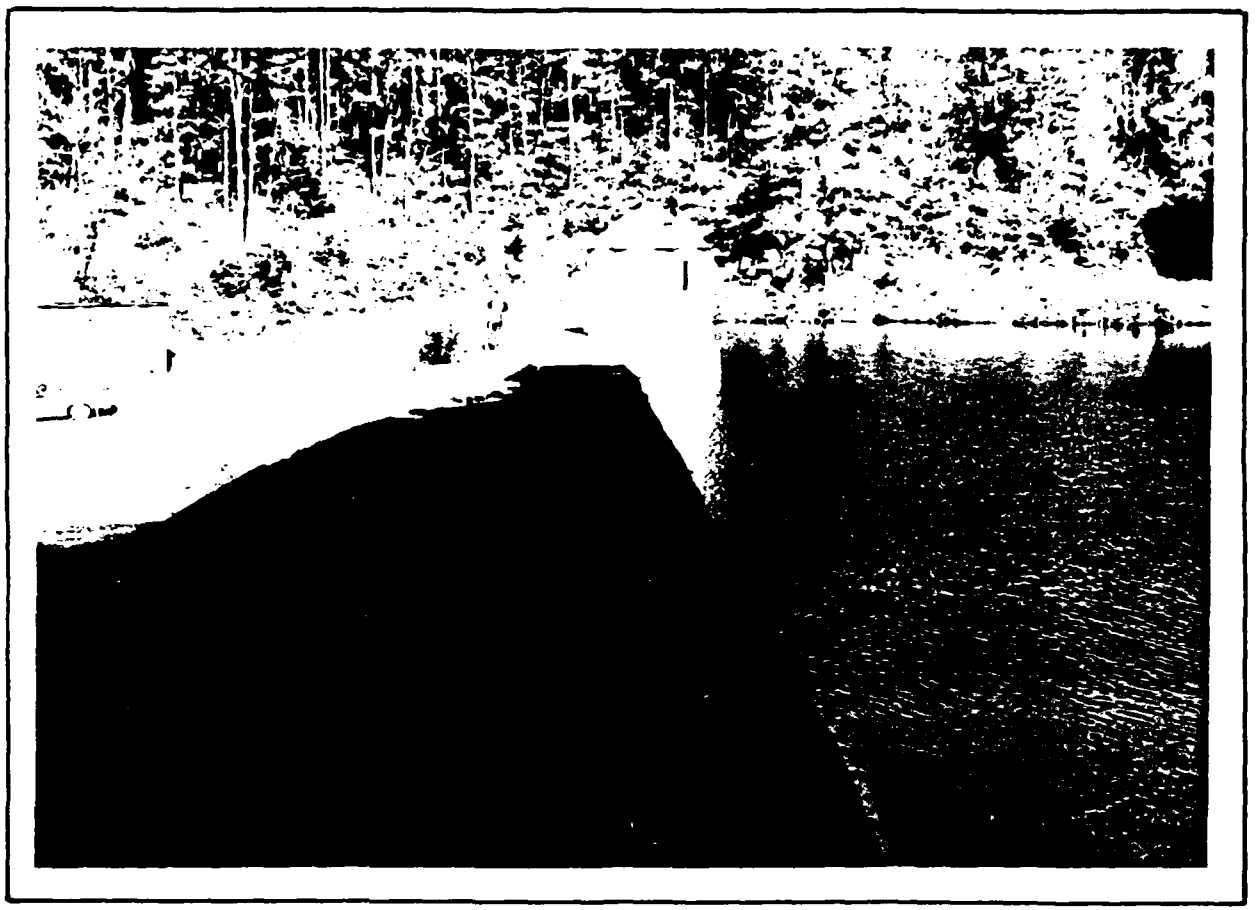


APPROVED BY:

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

DATE: 4 MARCH 81





OVERVIEW

LONG RUN RESERVOIR NO. 1 DAM

Photograph No. 1

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LONG RUN RESERVOIR NO. 1

NDI-ID NO. PA-00882
DER-ID NO. 13-004

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

A. Authority

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspections of dams throughout the United States.

B. Purpose

The purpose of this inspection is to determine if the dam constitutes a hazard to human life and property.

1.2 DESCRIPTION OF PROJECT

A. Description of Dam and Appurtenances

Note: Project spillway crest elevation is 107 (Appendix E, Plate III). The U.S.G.S. Quadrangle Sheet shows an estimated reservoir elevation 755. This estimated U.S.G.S. elevation is used in this report as the top of spillway crest.

Long Run Reservoir No. 1 Dam is an earthfill structure with an upstream stone wall constructed in 1885. The dam was lengthened and increased in height in 1911 and 1914 by placing a concrete facing and a parapet on the upstream side and additional fill on the downstream side (see Sections on Plates III and IV, Appendix E). The present length of the dam is about 310 feet and the height is 26 feet above streambed. The 30 foot wide spillway is located near the center of the dam at a design crest elevation of 3 feet below the top of dam.

The control structure is located at the upstream toe on the right side of the spillway. The gates in this structure are in open position. Discharge for the water supply is regulated in a valve house located at the downstream toe of the dam. Outside this valve house is a valve on a 12-inch blow-off line.

B. Location: Franklin Township, Carbon County
U.S.G.S. Quadrangle - Lehighton, PA
Latitude 40°-51.9', Longitude 75°-41.0'
Appendix E, Plates I & II

C. Size Classification: Small: Height - 26 feet
Storage - 73 acre-feet

D. Hazard Classification: High (Refer to Section 3.1.E.)

E. Ownership: Lehighton Water Authority
Mr. Clinton J. Williams, Manager
Municipal Building
Lehighton, PA 18235

F. Purpose: Water supply.

G. Design and Construction History

In 1885, an earthfill dam with a dry rubble upstream wall was constructed at this site. The rubble wall varied from 3 to 5 feet in width. To provide additional storage, this dam was increased in height in 1911. A three foot wide concrete facing was placed on the upstream side of the masonry section, and the dam was topped with a concrete wall, increasing the total height by 10 feet (Plate III, Appendix E). Immediately after construction was completed, considerable leakage occurred. Plans were submitted to the Water Supply Commission for improvements to the upstream facing of the wall. Construction started in the summer of 1914 and was completed in 1919. This work was accomplished under supervision of the owner.

H. Normal Operating Procedures

The upstream gates are always left open and have not been operated since at least 1951. Water can be fed into the reservoir by pumping from another reservoir. Water supply is by gravity from this reservoir or from an upstream reservoir through a bypass pipe. All flow above spillway crest elevation is discharged over the spillway. The blow off valve at the downstream toe has not been operated in the last 30 years.

1.3 PERTINENT DATA

A. Drainage Area (square miles)

From files:	2.7
Computed for this report:	1.07
Use:	1.07

B. Discharge at Dam Site (cubic feet per second)
See Appendix D for hydraulic calculations.

Maximum known flood (estimated from records of U.S.G.S. gage on nearby Wild Creek)	261
Outlet works at pool Elev. 755.0	17
Outlet works at low pool Elev. 740.0	9
Spillway capacity at pool Elev. 758.0 (low point of dam)	499

C. Elevation (feet above mean sea level)

Top of dam (low point)	758.0
Top of dam (design crest)	758.0
Spillway crest	755.0
Upstream portal invert	734.0
Downstream portal invert (estimated)	733.0
Streambed at downstream toe of dam (estimated)	732.0

D. Reservoir (miles)

Length of normal pool (Elev. 755.0)	.1
Length of maximum pool (Elev. 758.0)	.1

E. Storage (acre-feet)

Spillway crest (Elev. 755.0)	61.3
Top of dam (Elev. 758.0)	73

F. Reservoir Surface (acres)

Spillway crest (Elev. 755.0)	3.4
Top of dam (Elev. 758.0)	4.7

G. Dam

Refer to Plates III & IV in Appendix E for elevation and section.

Type: Earthfill dam with upstream concrete wall.

Length: 310 feet.

Height: 26 feet.

Top Width: Concrete parapet: 4.5 feet and 2.2 feet above embankment.
Earth dam: top berm width 10 feet.

Side Slopes: Upstream: Concrete facing top 12 feet vertical. Lower portion 1H to 1V.
Downstream: 1.9H to 1V (See Plate A-II, Appendix A).

Zoning: Concrete and rubble masonry wall at upstream face.

Cutoff: Trench excavated at upstream toe, filled with concrete. Trench depth varies 5 to 12 feet in depth.

Grouting: Some grouting in north abutment.

H. Outlet Facilities

Type: Blow off from 12" water supply main.

Closure: 12" valve at downstream end and non-operable gate in intake tower.

Location: Right side of spillway.

Note: Another blow-off valve is located between the valve house and 12" valve. This valve has not been operated and has no visible outlet.

I. Spillway

Type: Concrete broad crested weir.

Length of Weir: 30 feet.

Crest Elevation: 755

Location: Center of dam.

J. Regulating Outlets

See Section 1.3.H. above.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

A. Hydrology & Hydraulics

Engineering data on the hydrologic and hydraulic design for the Long Run Reservoir No. 1 Dam are not available. The dam was designed and constructed prior to the requirements for a permit. The files of the Pennsylvania Department of Environmental Resources (PennDER) indicate a drainage area of 2.7 square miles. The spillway has a design width of thirty feet, and the design crest is three feet below the top of dam (Plate III, Appendix E).

B. Embankment and Appurtenant Structures

Design data for the embankment and appurtenant structures are not available, except two drawings indicating typical sections and elevation of the reconstruction in 1911 and 1914 (Plates III & IV, respectively, Appendix E).

2.2 CONSTRUCTION

Available construction data is limited to five Progress Reports by PennDER during the reconstruction of the dam in 1914. These reports indicate that serious leakage occurred after the dam was increased in height in 1911. This leakage was noticeable at both abutments and near the valve house. Plans were submitted for remedial measures in 1914 and were approved on June 23, 1914. These plans indicate a trench excavation along the upstream toe. The trench was to be filled with concrete. The face of the wall was to be sealed with a one foot thick facing over the upper part of the wall. Additional fill was obtained from the upstream end of the reservoir and placed on the downstream embankment.

The construction reports indicate that the trench was excavated to a depth varying from 5 to 12 feet into a red sandstone or shale. Fissured sandstone in the south (left) abutment was grouted through pipes placed in the concrete cutoff wall. The trench excavation discovered that the original dam was placed on a gravel and sand mixture layer over the shale varying in depth from one to five feet. Construction was stopped in November, 1914, and was not completed until 1919. The cutoff wall was made at least two feet thick, and the wall facing was anchored into the old wall.

Letters indicate that the spillway deteriorated seriously in the 1930's and that spillway walls and slab were repaired in 1941. The cement mortar slab showed deterioration again in 1946.

2.3 OPERATION

Records of operation have not been maintained by the owner.

2.4 EVALUATION

A. Availability

The engineering data, available for examination, are limited to two drawings and five construction progress reports, all contained in the files of PennDER.

B. Adequacy

The available engineering data combined with the visual inspection are considered to be sufficiently adequate to make a reasonable assessment of the dam.

C. Operating Records

Operating records, including maximum pool levels, have not been maintained by the owner.

D. Post Construction Changes

The dam was constructed in 1885 and was increased in height in 1911. To reduce the leakage, a cutoff wall was constructed at the upstream toe in 1914 and the upstream face was refaced with a concrete wall.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

A. General

The general appearance of Long Run Reservoir No. 1 Dam is fair. The concrete parapet wall and the embankment are in apparent good condition. Seepage was noticed near the left abutment and behind the valve house. Estimates of quantities were not feasible due to location. Water would disappear in stone and weed growth. The spillway slab has deteriorated seriously. At the time of inspection, the water flowing over the spillway disappeared into cracks and crevasses and reappeared at the downstream end of the spillway.

The visual inspection check list and sketches of the general plan and profile of the dam, as surveyed during the inspection, are presented in Appendix A of this report. Mr. Clint Williams, Manager of the Water Authority, accompanied the inspectors.

Photographs taken on the day of inspection are reproduced in Appendix C.

B. Dam

The upstream side of the dam is formed by a concrete wall. The upstream face of this wall is vertical over the upper 12 feet. Below the 12 foot level the surface slopes at 1:1 to the bottom. Earthfill supports the wall on the downstream side. The top of the earthfill is 2.2 feet below the top of the concrete wall. The concrete wall is in good condition with only slight spalling at a few places. The earthfill embankment has a well maintained grass mat, except adjacent to the spillway where a footpath has worn away the protective cover (Photograph No. 3).

The embankment has a wide, sloping berm about 11.5 feet below the top of dam. This berm is 57 feet wide at the location of the section shown on Plate A-II, Appendix A. A masonry wall is located at the toe of the dam behind the valve house. Seepage was noticed through this wall and at the end of the wall. A considerable flow of water was observed seeping from the left hillside downstream from the toe of the fill. It appears that this flow travels from the reservoir, around the left abutment and daylights at the downstream toe. A concrete wall was placed in the reservoir upstream of the dam in an attempt to cut off this flow. This seepage has been reported since the dam was completed in 1911.

C. Appurtenant Structures

All inflow above spillway crest is discharged over a 30 foot wide, broad crested weir. The weir is 6.5 feet wide at the crest with a

vertical upstream side and a 1 to 1 slope on the downstream side (Photograph No. 4). The concrete of the weir, spillway and abutment walls is in good condition although some spalling has occurred. The spillway channel is nearly level below the weir. A flashboard was installed in the channel to form a shallow wading pool. The slab downstream from this pool has many cracks. The small inflow over the weir at the time of inspection disappeared through these cracks. The lower section of the spillway channel is formed with masonry walls and a rock-lined channel. The rock lining had been cemented. However, most cement had disintegrated. The rocks appeared to be too small to be stable during high discharges (Photobraph No. 6). A footbridge across the spillway channel has deteriorated.

The control tower is located at the upstream face of the dam. The valve or gate in this structure, which is used for control of the discharge through the outlet pipe, is always left in open position.

The outlet pipe has a blow-off valve at the downstream toe. This valve has not been operated during the past 30 years. Other valves, located in the valve house are for controlling the water supply distribution system.

D. Reservoir Area

The reservoir area is surrounded by woodlands. The left side is steep, the right side moderately steep. The slopes appear to be stable and excessive siltation is not expected. Long Run Reservoir No. 2 Dam is located about 1,800 feet upstream from the No. 1 dam. This upstream dam is an earthfill dam approximately twenty feet high with a concrete spillway near its center. The concrete spillway is a 20.5 foot long broad crested weir.

E. Downstream Channel

The downstream channel below the spillway is a rock-lined natural stream. Three trailer homes are located about 1000 feet downstream from the dam at a point where the access road joins another road. Farther downstream other homes are located close to the stream. There is a potential hazard to loss of life downstream if the dam would fail. The hazard category for this dam is considered to be "high."

3.2 EVALUATION

The overall visual evaluation of the facilities indicates that the dam is in fair condition. The seepage is not considered serious at the present time. The footpath on the embankment should be sodded to prevent erosion if overtopping would occur. The cracked spillway slab should be repaired. The downstream end of the spillway should be provided with stable large rock or a concrete slab. Repair of the footbridge is recommended. The valves and gates on the upstream and downstream ends of the blow-off lines should be maintained and operated on a regular basis.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The Long Run Reservoir No. 1 Dam is used for water supply. Operational procedures are limited to adjustment of valves in the valve house as required for the water supply. A reservoir at normal pool elevation is desired by the owner. All inflow above the spillway crest is discharged through the spillway.

4.2 MAINTENANCE OF DAM

The embankment slopes are covered with a well maintained grass mat except for a footpath near the right spillway wall. The concrete wall is in good condition.

4.3 MAINTENANCE OF OPERATING FACILITIES

Only the valves in the valve house are operated on a regular basis. The upstream control gate is in the open position and has not been maintained or operated for many years. The valve controlling the emergency blow-off has not been maintained or operated in the past 30 years.

4.4 WARNING SYSTEM

Daily surveillance of the facilities is maintained, mainly due to visits to the valve house and chlorination building. During heavy and prolonged percipitation, a closer observance is maintained. However, a formal surveillance and downstream warning system does not exist at the present time.

4.5 EVALUATION

The operational procedures for these facilities are minimal. These procedures should include the maintenance and regular operation of the upstream gate and the downstream blow-off valve. A formal surveillance and downstream warning system should be developed for use during periods of high or prolonged rainfall.

SECTION 5 - HYDROLOGY/HYDRAULICS

5.1 EVALUATION OF FEATURES

A. Design Data

The hydrologic and hydraulic analyses available from PennDER for Long Run Reservoir No. 1 Dam were not very extensive. No stage-discharge curve, stage-storage curve, unit hydrograph, or flood routings were contained in the PennDER files.

B. Experience Data

There are no records of flood levels at Long Run Reservoir No. 1 Dam. Based on records of the U.S.G.S. stream gage on Wilk Creek at nearby Hatchery, Pennsylvania, the maximum inflow to Long Run Reservoir No. 1 is estimated to be 261 cfs. This flood was passed without reported difficulties.

C. Visual Observations

During the inspection, it was noted that the blow off pipe was not operable. The concrete in the spillway chute was heavily cracked and water was being lost through the chute slab. No other conditions were observed that would indicate that the appurtenant structures of the dam could not operate satisfactorily during a flood event until the dam is overtopped. There is one dam located upstream from Long Run Reservoir No. 1. This dam has been considered in the hydrologic analysis (Appendix D).

D. Overtopping Potential

Long Run Reservoir No. 1 Dam has a total storage capacity of 73 acre-feet at its present low point elevation and an overall height of 26 feet. These dimensions indicate a size classification of "Small"; the hazard classification is "High" (see Section 3.1.E.).

The Spillway Design Flood (SDF) for a dam having the above classification is in the range of one-half the Probable Maximum Flood (PMF) to the full PMF. For this dam, the recommended SDF is one-half the PMF. The SDF peak inflow is 1091 cfs (see Appendix D for HEC-1 inflow computations).

Comparison of the estimated SDF peak inflow of 1091 cfs with the estimated spillway discharge capacity of 499 cfs, based on the low point elevation on the crest, indicates that a potential for overtopping of the Long Run Reservoir No. 1 Dam exists.

An estimate of the storage effect of the reservoir and routing of the computed inflow hydrograph through the reservoir shows that this

dam does not have the necessary storage available to pass the SDF without overtopping. The spillway-reservoir system can pass a flood event equal to 23% of a PMF.

E. Dam Break Evaluation

Although Long Run Reservoir No. 1 Dam does not overtop until the magnitude of a flood event exceeds 23% of a PMF, the SDF will cause overtopping of about one foot. Since the dam has a concrete section, this amount of overtopping is not expected to cause failure. The upstream dam at Long Run Reservoir No. 2 overtops with about the same discharge. It was noted that the upstream dam has an earth embankment and is expected to attain water levels that would result in a breach when flood events of less magnitude than the SDF occurred. For this reason, it was assumed that the upstream dam would fail when the water level reached an elevation that would result in a breach. Being an earth embankment, it is judged that the breach would be completed within a 15 minute through two hour time interval. For this analysis, the most conservative condition, the 15 minute breach, was considered. This breach of the upstream dam is not expected to cause failure of Long Run Reservoir No. 1 Dam.

F. Spillway Adequacy

The small size category and high hazard category, in accordance with the Corps of Engineers' criteria and guidelines, indicates that the SDF for this dam should be in the range of one-half the PMF to the full PMF. For this dam the recommended SDF is one-half the PMF.

Calculations show that the combined spillway discharge capacity and reservoir storage capacity are capable of handling 23% of the PMF when the upstream dam remains intact (see Appendix D).

Since the combined spillway discharge and reservoir storage capacity cannot pass the SDF, and since the SDF is not expected to cause failure, the spillway capacity is judged to be inadequate but not seriously inadequate.

The hydrologic analysis for this investigation was based upon existing conditions of the watershed. The effects of future development were not considered.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

A. Visual Observations

1. Dam

The visual inspection of Long Run Reservoir No. 1 Dam did not detect any signs of dam instability. The concrete section is supported on the downstream side by a wide embankment. The crest of the concrete wall is level and the embankment slopes are flat and stable. The present seepage is not considered to effect the stability of the dam.

2. Appurtenant Structures

The spillway weir is in good condition; however, weathering has exposed some aggregate. The lower part of the spillway channel has many cracks in the slabs, permitting water to run under these slabs. Downstream from these cracked slabs there is an unpaved section with small stones. Washouts have occurred and could occur again with a large spillway discharge.

B. Design and Construction Data

1. Dam

The design and construction data consists of limited typical cross sections and construction progress reports. The masonry wall with concrete facing is not stable without using the passive resistance of the earthfill of the embankment. The embankment is wide and stable. The original dam was founded on a layer of sand and gravel and considerable seepage was to be expected. The placement of the cutoff wall at the upstream toe has provided a good seal against this seepage. Seepage is apparently following a path through the left hillside.

2. Appurtenant Structures

The design and construction data of the appurtenant structures are too limited to review any details. The spillway chute was constructed on fill and cracking of the slabs has occurred.

C. Operating Records

Operating records for this dam have not been maintained by the owner. There are no indications of serious problems except the reported seepage and disintegration of the downstream spillway slabs.

D. Post Construction Changes

The original dam was increased in height in 1911 by placing a concrete wall on top of the masonry wall and refacing the old masonry wall. Additional fill placed in 1914 has stabilized the concrete section. The cutoff wall has reduced the seepage under the dam and through the dam abutments.

E. Seismic Stability

This dam is located in Seismic Zone 1, and it is considered that the static stability is sufficient to withstand minor earthquake-induced dynamic forces. No studies or calculations have been made to confirm this assumption.

SECTION 7 - ASSESSMENT AND RECOMMENDATIONS

7.1 DAM ASSESSMENT

A. Safety

The visual inspection and the review of the construction drawings indicate that Long Run Reservoir No. 1 Dam is in fair condition. The field inspection did not detect any signs of instability. The seepage near the downstream toe is not considered to be serious at the present time. The spillway channel needs rehabilitation.

The hydrologic and hydraulic computations indicate that the combination of storage capacity and the spillway discharge capacity are able to pass 23% of the PMF without overtopping the dam. However, it is expected that overtopping caused by the SDF will not result in failure of the dam. The spillway is inadequate but not seriously inadequate.

B. Adequacy of Information

The limited design information contained in the files combined with the visual inspection are considered sufficiently adequate for making a reasonable assessment of this dam.

C. Urgency

The recommendations presented below should be implemented immediately.

D. Additional Studies

Additional investigations are required to determine measures necessary to provide an adequate spillway capacity.

7.2 RECOMMENDATIONS

In order to assure the continued satisfactory operation of this dam, the following recommendations are presented for immediate implementation by the owner:

1. That measures shall be taken to provide an adequate spillway capacity.

2. That the cracked spillway slab be repaired.

3. That the downstream end of the spillway be protected from washouts during large discharges.

4. That the upstream gates be maintained and operated on a regular basis.

5. That the downstream blow-off valves be maintained and operated on an annual basis.

6. That the seepage be monitored on a regular basis. If turbidity or an increase in flow is detected, immediate action shall be taken to correct this condition.

7. That the slope of the embankment adjacent to the spillway be provided with a protective cover.

8. That the footbridge over the spillway chute be repaired.

9. That a formal surveillance and downstream warning system be developed for use during periods of high or prolonged rainfall.

10. That an operation and maintenance manual be prepared for guidance in the operation of the dam during normal and emergency conditions, and that a schedule be developed for the annual inspection of the dam and its appurtenant structures.

APPENDIX A

CHECK LIST OF VISUAL INSPECTION REPORT

CHECK LIST

PHASE I - VISUAL INSPECTION REPORT

PA DER # 13-4 NDI NO. PA-00882

NAME OF DAM Long Run Reservoir No. 1 HAZARD CATEGORY High

TYPE OF DAM Earthfill with stone masonry and concrete upstream wall.

LOCATION Franklin TOWNSHIP Carbon COUNTY, PENNSYLVANIA

INSPECTION DATE 10/22/80 WEATHER Clear-Sunny TEMPERATURE 40-50°

INSPECTORS: R. Houseal (Recorder) OWNER'S REPRESENTATIVE(s):

H. Jongsma Clint Williams

R. Shireman

A. Bartlett

NORMAL POOL ELEVATION: 755.0 U.S.G.S. (Estimated) AT TIME OF INSPECTION:

BREAST ELEVATION: 758.0 (Design) POOL ELEVATION: 755.1

SPILLWAY ELEVATION: 755.0 TAILWATER ELEVATION: 730.0

MAXIMUM RECORDED POOL ELEVATION: Unknown

GENERAL COMMENTS:

The dam appears to be in fair condition. Evidence of seepage through the embankment was not observed. Seepage was, however, located in the left abutment and near the valve house. The spillway slab shows signs of deterioration of the concrete surface. Top of concrete wall is spalled.

NDI NO. PA-00382

VISUAL INSPECTION
EMBANKMENT

	OBSERVATIONS AND REMARKS
A. SURFACE CRACKS	There are no signs of cracks on the embankment portions of the dam.
B. UNUSUAL MOVEMENT BEYOND TOE	None observed.
C. SLOUGHING OR EROSION OF EMBANKMENT OR ABUTMENT SLOPES	None observed, except footpath on right side of spillway.
D. ALIGNMENT OF CREST: HORIZONTAL: VERTICAL:	Downstream embankment section appears uniform. Refer to profile for vertical data (Plate A-II).
E. RIPRAP FAILURES	No riprap. Upstream is vertical concrete masonry wall.
F. JUNCTION EMBANKMENT & ABUTMENT OR SPILLWAY	Abutments with spillway and natural ground appear to be good.
G. SEEPAGE	There is a persistent seepage condition through and/or around the left abutment. The seepage discharges well below the downstream toe of slope and is concentrated in a small area. Seepage at the downstream
H. DRAINS	wall behind the valve house. None.
J. GAGES & RECORDER	None.
K. COVER (GROWTH)	Crest behind concrete wall and downstream slope are covered with grass and weeds which are closely mowed.

NDI NO. PA-00882

VISUAL INSPECTION
OUTLET WORKS

	OBSERVATIONS AND REMARKS
A. INTAKE STRUCTURE	Circular concrete block structure is located to right of spillway upstream from the dam. One valve stem controls water supply.
B. OUTLET STRUCTURE	Valve house for drinking water supply.
C. OUTLET CHANNEL	None.
D. GATES	One blow-off valve.
E. EMERGENCY GATE	See Above.
F. OPERATION & CONTROL	Not used in at least 30 years.
G. BRIDGE (ACCESS)	None. From top of dam.

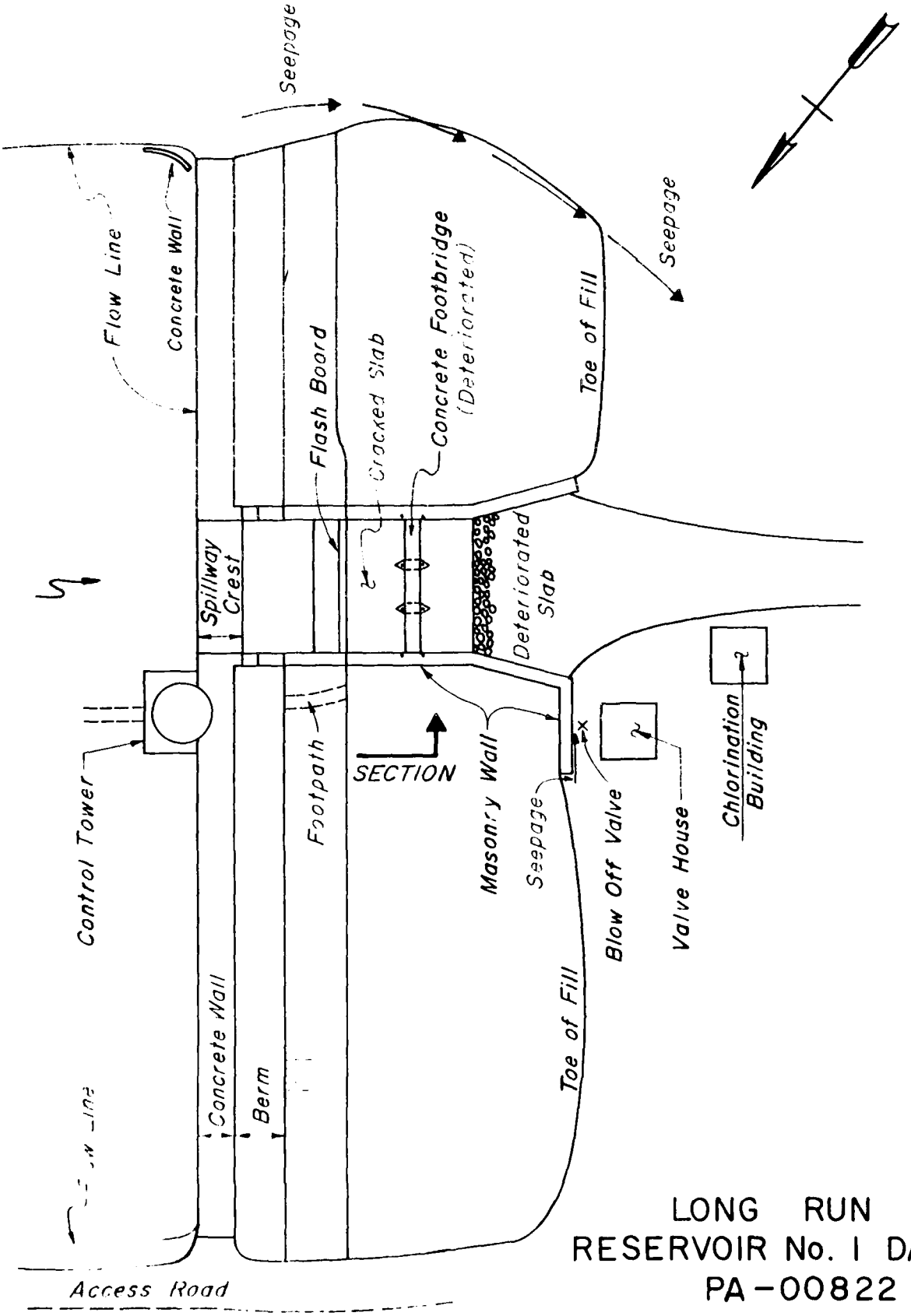
NDI NO. PA-00882

VISUAL INSPECTION
SPILLWAY

	OBSERVATIONS AND REMARKS
A. APPROACH CHANNEL	Directly from reservoir.
B. WEIR: Crest Condition Cracks Deterioration Foundation Abutments	Concrete broad crested. Surface in good condition but weathered due to flow - aggregate exposed. Walls of spillway are spalled; in many areas aggregate exposed - some leaching of lime visible.
C. DISCHARGE CHANNEL: Lining Cracks Stilling Basin	Flashboards across paved outlet channel form shallow basin at bottom of sloped spillway chute. Masonry walls below (downstream of) concrete walls are in good condition. Slabs in outlet channel are cracked. Serious deterioration at downstream end.
D. BRIDGE & PIERS	Concrete footbridge across outlet channel. Poor condition, badly deteriorated (three span - 2 piers). Pipe hand rails are in good condition.
E. GATES & OPERATION EQUIPMENT	Spillway is uncontrolled.
F. CONTROL & HISTORY	None.

VISUAL INSPECTION

	OBSERVATIONS AND REMARKS
INSTRUMENTATION	
Monumentation	None.
Observation Wells	None.
Weirs	None.
Piezometers	None.
Staff Gauge	None.
Other	None.
RESERVOIR	
Slopes	Woodlands.
Sedimentation	None reported.
Watershed Description	Woodlands.
DOWNSTREAM CHANNEL	
Condition	Rock bottom natural stream.
Slopes	Woodlands.
Approximate Population	10.
No. Homes	3 trailers immediately downstream.

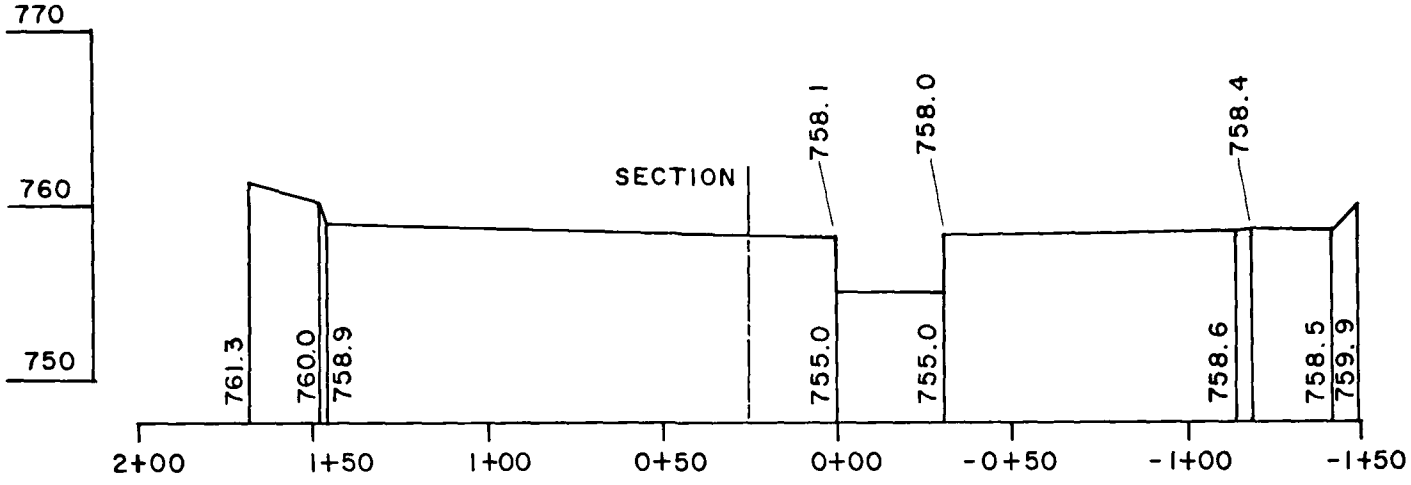


LONG RUN RESERVOIR No. 1 DAM
PA-00822

INSPECTION SURVEY

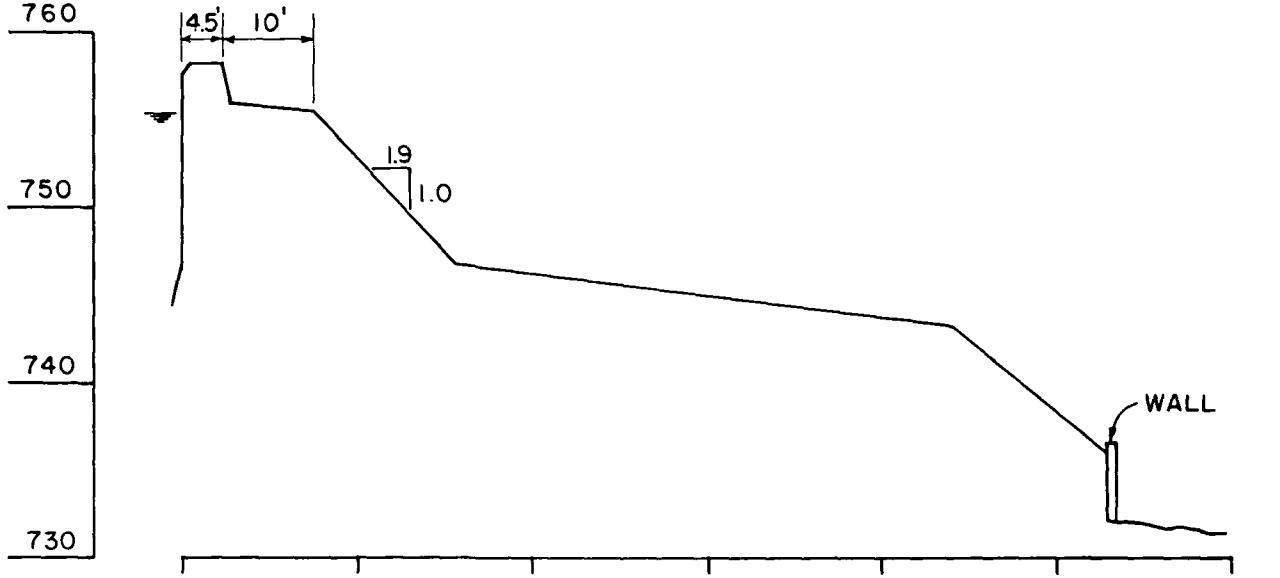
SURVEYED 10-22-80

PLATE A-I



EMBANKMENT PROFILE

LOOKING UPSTREAM



EMBANKMENT SECTION STA. 0+25

SURVEYED 10-22-80

LONG RUN
RESERVOIR No. 1 DAM
PA-00822
INSPECTION SURVEY

PLATE A-II

APPENDIX B

CHECK LIST OF ENGINEERING DATA

CHECK LIST
ENGINEERING DATA

PA DER # 13-004 NDI NO. PA-00882

NAME OF DAM Long Run Reservoir No. 1

ITEM	REMARKS
AS-BUILT DRAWINGS	Not available.
REGIONAL VICINITY MAP	U.S.G.S. Quadrangle - Lehighton, Pa. See Plate II, Appendix E
CONSTRUCTION HISTORY	Dam constructed in 1885. Height increased in 1911. New upstream facing and cutoff wall constructed in 1914.
GENERAL PLAN OF DAM	Not available.
TYPICAL SECTIONS OF DAM	Plate III, Appendix E - 1911 construction. Plate IV, Appendix E - 1914 repairs.
OUTLETS: PLAN DETAILS CONSTRAINTS DISCHARGE RATINGS	No details of outlet.

NDI NO. PA-00882

ENGINEERING DATA

ITEM	REMARKS
RAINFALL & RESERVOIR RECORDS	No records.
DESIGN REPORTS	None.
GEOLOGY REPORTS	No reports. Construction reports indicate a gravel layer between the dam foundation and underlying red sandstone and shale.
DESIGN COMPUTATIONS: HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None.
MATERIALS INVESTIGATIONS: BORING RECORDS LABORATORY FIELD	None.
POST CONSTRUCTION SURVEYS OF DAM	"Water Supply System Improvement Study" by GFCC, in 1969. This report discusses the need of repairs on the spillway, without indicating an in depth study of the dam.
BORROW SOURCES	Reports indicate that the height of fill was increased in 1914 by about 6 feet behind the wall. Material was obtained from the up-stream end of reservoir.

NDI NO. PA-00882

ENGINEERING DATA

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	None since 1914.
HIGH POOL RECORDS	No records.
POST CONSTRUCTION ENGINEERING STUDIES & REPORTS	"Water Supply System Improvement Study" by Gannett, Fleming, Corddry & Carpenter, Inc., in 1969. This report deals mostly with water distribution system.
PRIOR ACCIDENTS OR FAILURE OF DAM Description: Reports:	None.
MAINTENANCE & OPERATION RECORDS	No records.
SPILLWAY PLAN, SECTIONS AND DETAILS	Section on Plate III, Appendix E.

ENGINEERING DATA

ITEM	REMARKS
OPERATING EQUIPMENT, PLANS & DETAILS	Valves located in valve house at downstream toe. Blow-off valve located near valve house. Pipes have non-operable gates at upstream end.
CONSTRUCTION RECORDS	Progress Reports in PennDER file of the repairs in 1914.
PREVIOUS INSPECTION REPORTS & DEFICIENCIES	No reports.
MISCELLANEOUS	

NDI NO. PA-00882

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Woodland.

ELEVATION:

TOP NORMAL POOL & STORAGE CAPACITY: Elev. 755 Acre-Feet 61.3

TOP FLOOD CONTROL POOL & STORAGE CAPACITY: Elev. 756 Acre-Feet 73

MAXIMUM DESIGN POOL: Elev. 758

TOP DAM: Elev. 758

SPILLWAY:

a. Elevation 755

b. Type Concrete broad crested weir.

c. Width 30'

d. Length ---

e. Location Spillover Center of dam.

f. Number and Type of Gates None.

OUTLET WORKS:

a. Type 12" blow-off from water supply main.

b. Location Right side of spillway.

c. Entrance inverts 734

d. Exit inverts 733

e. Emergency drawdown facilities 12" blow-off.

HYDROMETEOROLOGICAL GAGES:

a. Type None.

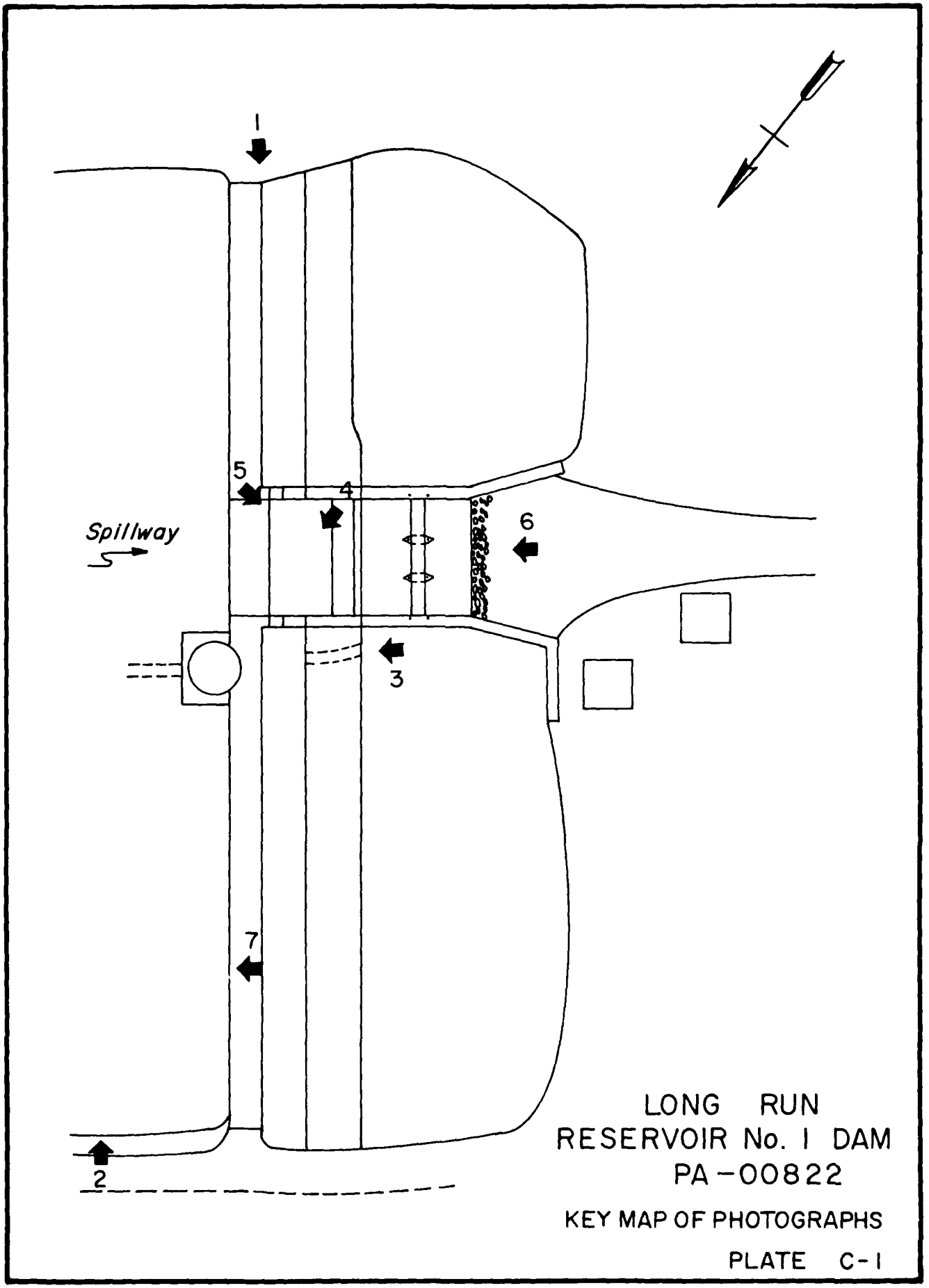
b. Location

c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 499 cfs.

APPENDIX C

PHOTOGRAPHS

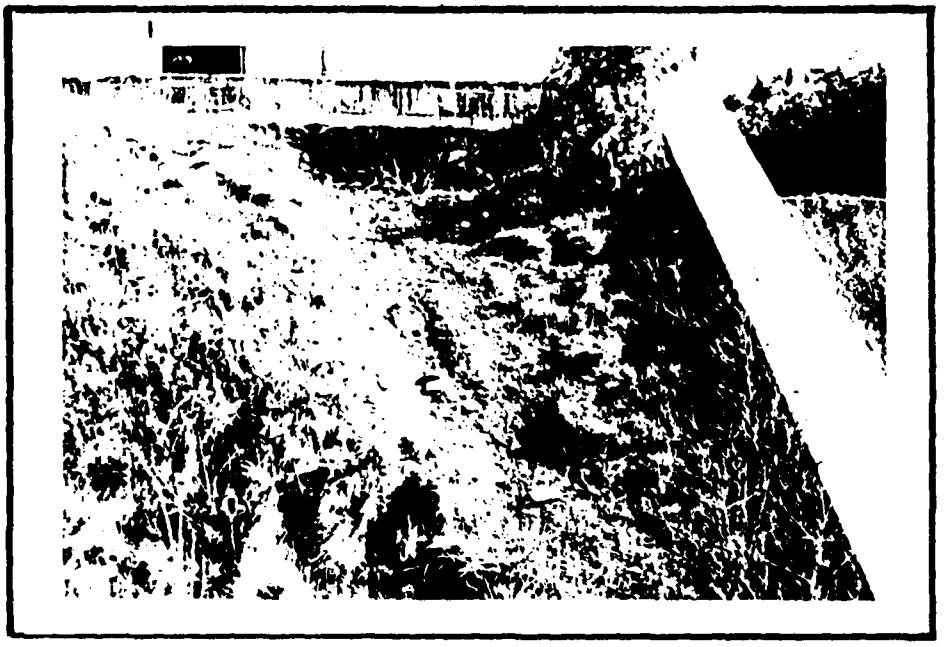


LONG RUN
RESERVOIR No. 1 DAM
PA-00822

KEY MAP OF PHOTOGRAPHS

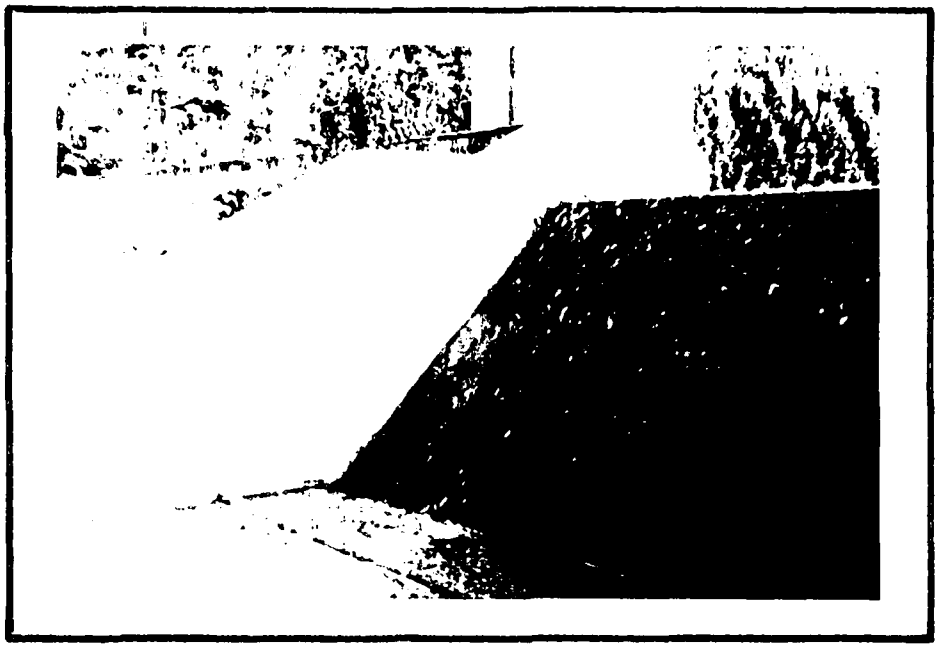
PLATE C-1

UPSTREAM FACE FROM RIGHT ABUTMENT - NO. 2

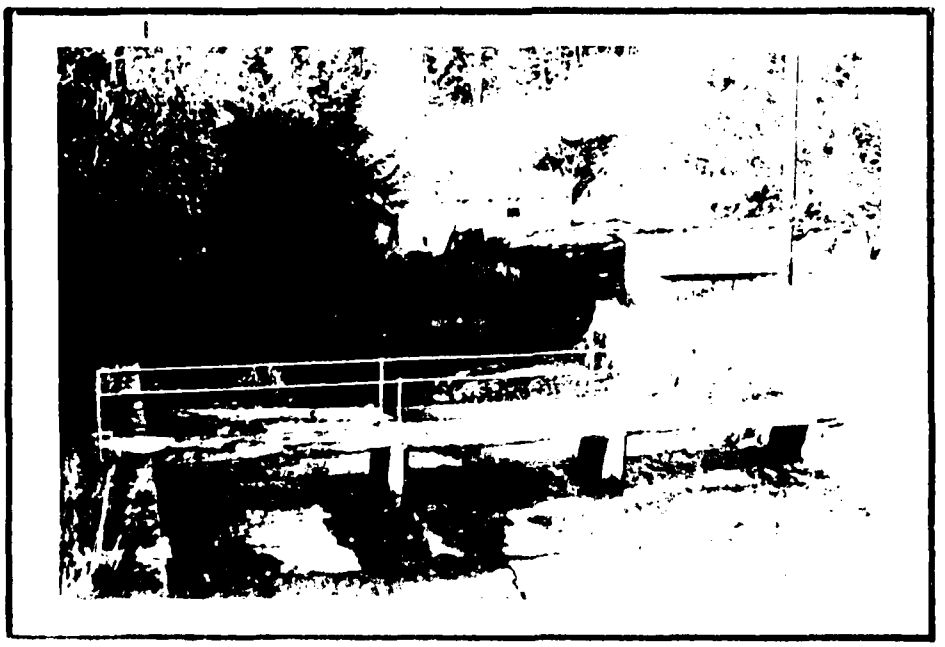


FOOTPATH ON RIGHT SIDE OF SPILLWAY - NO. 3

PA-00882
Plate C-11

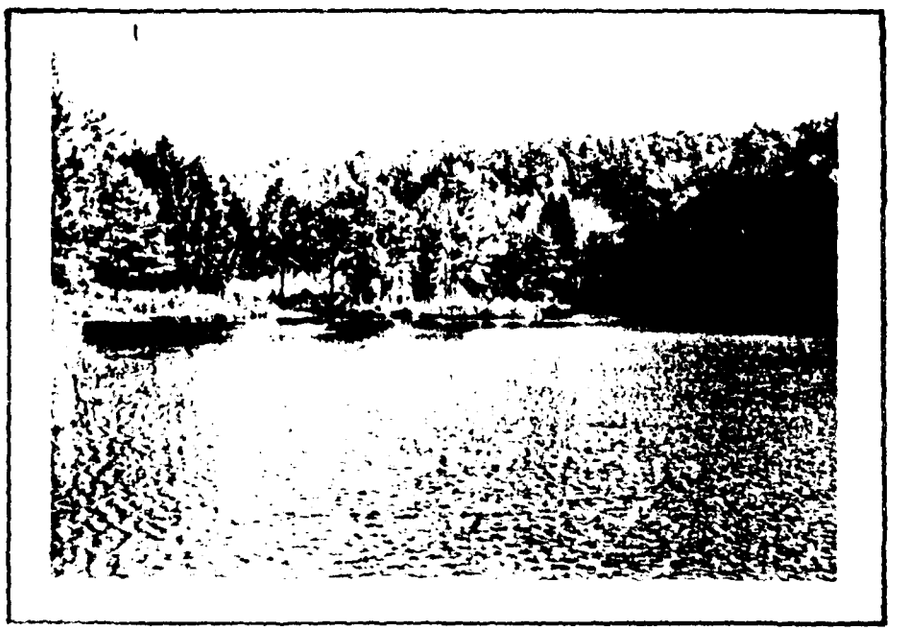


DOWNSTREAM FACE OF SPILLWAY - NO. 4



SPILLWAY CHANNEL LOOKING DOWNSTREAM - NO. 5

DETAIL OF DETERIORATED SPILLWAY SLAB
BELOW FOOTBRIDGE - NO. 6



RESERVOIR AREA - NO. 7

PA-00882
Plate C-IV

APPENDIX D

HYDROLOGY AND HYDRAULIC CALCULATIONS

SUMMARY DESCRIPTION
OF
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION

The hydrologic and hydraulic evaluation for this inspection report has employed computer techniques using the Corps of Engineers computer program identified as the Flood Hydrograph Package (HEC-1) Dam Safety Version.

The program has been designed to enable the user to perform two basic types of hydrologic analyses: (1) the evaluation of the overtopping potential of the dam, and (2) the capability to estimate the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. A brief summary of the computation procedures typically used in the dam overtopping analysis is shown below.

- Development of an inflow hydrograph to the reservoir.
- Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.
- Routing of the outflow hydrograph(s) of the reservoir to desired downstream locations. The results provide the peak discharge and maximum stage of each routed hydrograph at the outlet of the reach.

The output data provided by this program permits the comparison of downstream conditions just prior to a breach failure with that after a breach failure and the determination as to whether or not there is a significant increase in the hazard to loss of life as a result of such a failure.

The results of the studies conducted for this report are presented in Section 5.

For detailed information regarding this program refer to the Users Manual for the Flood Hydrograph Package (HEC-1) Dam Safety Version prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California.

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: Long Run Reservoir No. 1 RIVER BASIN: Delaware

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.5 INCHES/24 HOURS[1]

(FOR FOOTNOTES SEE NEXT PAGE)

STATION		1	2	3	4
STATION DESCRIPTION		Long Run Reservoir No. 2	Long Run Reservoir No. 2 Dam	Long Run Reservoir No. 1	Long Run Reservoir No. 1 Dam
DRAINAGE AREA (SQUARE MILES)		.91		.16	
CUMULATIVE DRAINAGE AREA (SQUARE MILE)		.91	.91	1.07	1.07
ADJUSTMENT OF PMP FOR DRAINAGE AREA (%)[2]	6 HOURS	113		113	
	12 HOURS	123		123	
	24 HOURS	132		132	
	48 HOURS	142		142	
	72 HOURS	---		---	
	Zone 6				
SNYDER HYDROGRAPH PARAMETERS	ZONE[3]	2		2	
	C_p / C_t[4]	.45/2.1		.45/2.1	
	L (MILES)[5]	1.60		.75	
	L_{ca} (MILES)[5]	.63		.25	
	$T_p = C_t (L \cdot L_{ca})^{0.3}$ (Hours)	2.11		1.27	
SPILLWAY DATA	CREST LENGTH (FT.)		20.5		30
	FREEBOARD (FT.)		4		3
	DISCHARGE COEFFICIENT		2.7		3.2
	EXPONENT		1.5		1.5
	ELEVATION		830		755
AREA[6] (ACRES)	NORMAL POOL				
	ELEV. _____	830 = 1.3 840 = 4.8		755 = 3.4 760 = 5.5 780 = 9.5	
	ELEV. _____				
STORAGE (ACRE - FEET)	NORMAL POOL[7]				
	ELEV. _____[8]	830 = 10.7 805.3 = 0		755 = 61.3 700.9 = 0	
	ELEV. _____[8]				
	ELEV. _____[8]				

(1) Hydrometeorological Report 33 (Figure 1), U.S. Army, Corps of Engineers, 1956.

(2) Hydrometeorological Report 33 (Figure 2), U.S. Army, Corps of Engineers, 1956.

(3) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients (C_p and C_t).

(4) Snyder's Coefficients.

(5) L = Length of longest water course from outlet to basin divide.

L_{ca} = Length of water course from outlet to point opposite the centroid of drainage area.

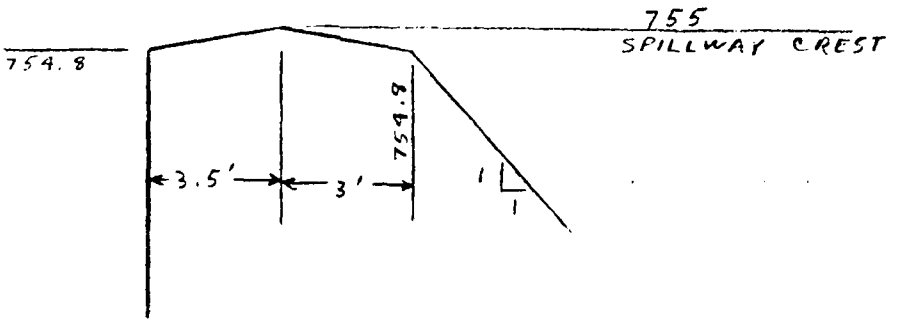
(6) Planimetered area encompased by contour upstream of dam.

(7) PennDER files.

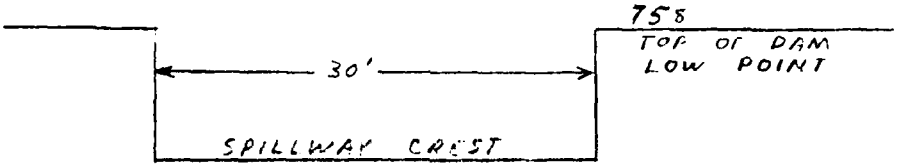
(8) Computed by conic method.

BY AL S DATE 12/.180 **BERGER ASSOCIATES** SHEET NO. 1 OF 7
CHKD. BY DATE PROJECT D0590
SUBJECT LONG RUN RESERVOIR #1

SPILLWAY RATING



BROAD CRESTED WEIR
C = 3.2 (ESTIMATED FROM KING'S HDBK)



$Q = C L H^{3/2}$

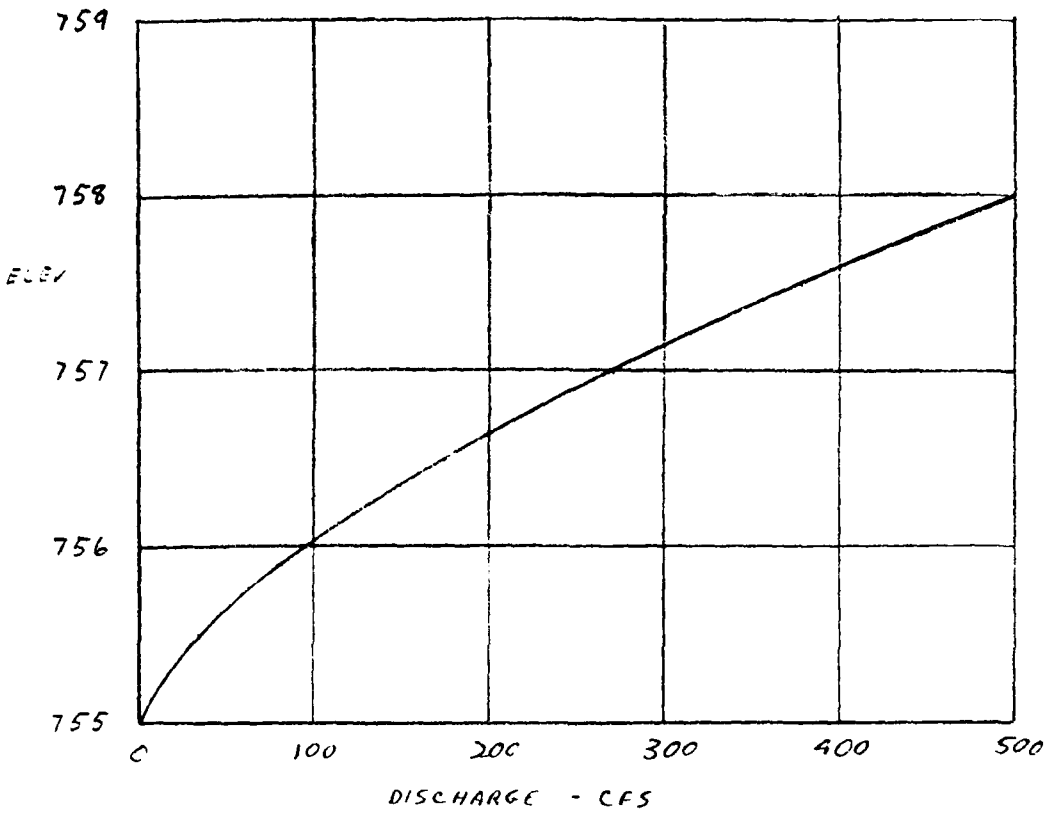
$H = 758 - 755 = 3'$

$Q = 3.2 \times 30 \times (3)^{1.5}$

$= 499$ CFS

BY RLC DATE 12/2/89 **BERGER ASSOCIATES** SHEET NO. 2 OF 7
CHKD. BY DATE PROJECT D0590
SUBJECT LONG RUN RESERVOIR #1

SPILLWAY RATING CURVE



BY RLS DATE 12/24/80 **BERGER ASSOCIATES** SHEET NO. 3 OF
CHKD. BY DATE PROJECT 05590
SUBJECT LONG RUN RESERVOIR #1

DISCHARGE THROUGH OUTLET WORKS

12" DIA. PIPE $C = 0.6$ (KINGS HOBK)

INVERT ELEV. = 734

$$Q = CA\sqrt{2gH}$$

AT POOL LEVEL 755

$H = 755 - 734.5 = 20.5'$

$$Q = 0.6 \times (\pi \times (1)^2/4) \times (2 \times 32.2 \times 20.5)^{0.5}$$

$= 17$ CFS

AT LOW POOL LEVEL 740

$H = 740 - 734.5 = 5.5'$

$$Q = 0.6 \times (\pi \times (1)^2/4) \times (2 \times 32.2 \times 5.5)^{0.5}$$

$= 9$ CFS

BY RLS DATE 12/2/80 **BERGER ASSOCIATES** SHEET NO. 4 OF 7
CHKD. BY DATE PROJECT D0590
SUBJECT LONG RUN RESERVOIR #1

EMBANKMENT RATING

$Q = C L H^{3/2}$ $C = 2.7$ (KING'S HDBK)

AT ELEV 758.5

$2.7 \times 73 \times (.2)^{1.5} = 18$
$2.7 \times 70 \times (.25)^{1.5} = 24$ $\Sigma = 42$ CFS

AT ELEV 759

$2.7 \times 146 \times (.5)^{1.5} = 139$
$2.7 \times 2 \times (.05)^{1.5} = -$
$2.7 \times 84 \times (.7)^{1.5} = 133$
$2.7 \times 2 \times (.5)^{1.5} = 2$
$2.7 \times 25 \times (.55)^{1.5} = 28$
$2.7 \times 3 \times (.29)^{1.5} = 1$ $\Sigma = 303$ CFS

AT ELEV 759.5

$2.7 \times 146 \times (1)^{1.5} = 394$
$2.7 \times 11 \times (.3)^{1.5} = 5$
$2.7 \times 84 \times (1.2)^{1.5} = 298$
$2.7 \times 2 \times (1)^{1.5} = 5$
$2.7 \times 25 \times (1.05)^{1.5} = 73$
$2.7 \times 5 \times (.5)^{1.5} = 5$ $\Sigma = 780$ CFS

AT ELEV 760

$2.7 \times 146 \times (1.5)^{1.5} = 724$
$2.7 \times 21 \times (.55)^{1.5} = 23$
$2.7 \times 84 \times (1.7)^{1.5} = 503$
$2.7 \times 2 \times (1.5)^{1.5} = 10$
$2.7 \times 25 \times (1.55)^{1.5} = 130$
$2.7 \times 7 \times (.9)^{1.5} = 14$ $\Sigma = 1404$ CFS

MAXIMUM KNOWN FLOOD AT DAMSITE

THERE ARE NO RECORDS OF FLOOD LEVELS AT THIS DAM. BASED ON RECORDS OF THE STREAM GAGING STATION ON WILD CREEK AT NEARBY HATCHERY, PA. (D.A. = 16.8 SQ.MI.) THE MAXIMUM DISCHARGE AT THE GAGE OCCURRED IN MAY 1942 WHEN A DISCHARGE OF 2360 CFS WAS RECORDED. THE MAXIMUM INFLOW TO LONG RUN RESERVOIR NO. 1 IS ESTIMATED TO BE:

$$\left(\frac{1.07}{16.8}\right)^{0.8} \times 2360 = 261 \text{ CFS}$$

DESIGN FLOOD

SIZE CLASSIFICATION

MAXIMUM STORAGE = 73 ACRE-FEET
MAXIMUM HEIGHT = 26 FEET
SIZE CLASSIFICATION IS "SMALL"

HAZARD CLASSIFICATION

SEVERAL HOMES ARE LOCATED ALONG THE DOWNSTREAM CHANNEL.
USE "HIGH"

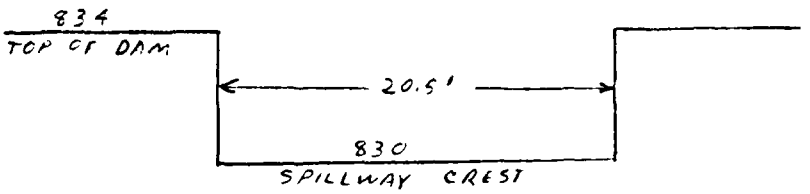
RECOMMENDED SPILLWAY DESIGN FLOOD

THE ABOVE CLASSIFICATIONS INDICATE USE OF AN SDF EQUAL TO ONE-HALF PMF TO THE FULL PROBABLE MAXIMUM FLOOD.

UPSTREAM RESERVOIR

LONG RUN RESERVOIR #2

20' HIGH EARTH DAM
250' LONG
(FROM PENNDER FILES
SPILLWAY FIELD CHECKED)



BROAD CRESTED WEIR
C = 2.7 (KINGS HDBK)

EMBANKMENT C = 2.7

$Q = C L H^{3/2}$

$= 2.7 \times 20.5 \times (4)^{1.5}$

$= 443$ CFS

BREACH ASSUMPTIONS (RESERVOIR #2)

BREACH WIDTH = 50'

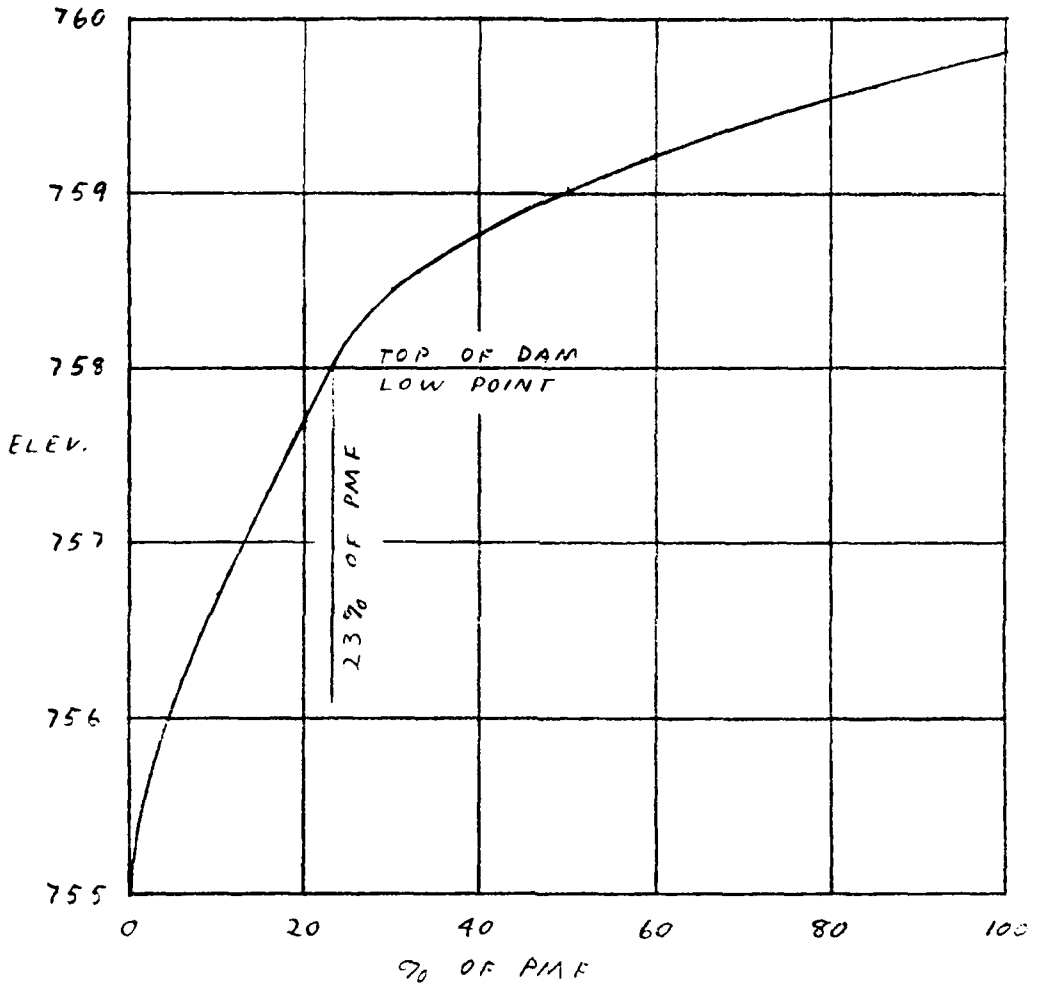
SIDE SLOPES (EARTH EMBANKMENT) = 1:1

FAILURE TIME (EARTH EMBANKMENT) =
BETWEEN 15 MIN. AND 2 HR.

POOL LEVEL AT FAILURE: EARTH EMBANKMENT
SAY 0.5 FT OVER TOP OF DAM

BY RLS DATE 12/3/80 **BERGER ASSOCIATES** SHEET NO. 7 OF 7
CHKD. BY DATE PROJECT D0590
SUBJECT LONG RUN RESERVOIR #1

SPILLWAY CAPACITY CURVE



JULY 1978
LAST MODIFICATION 26 FEB 79
****

```
A1                LONG RUN RESERVOIR NO. 1 DAM    ****    LONG RUN
A2                FRANKLIN TWP., CARBON COUNTY, PA.
A3                NDI # PA-00882      PA DER # 13-4
B    300      0     15      0      0      0      0      0     -4      0
B1     5
J      1      9      1
J1     1    .85     .7     .6     .5     .4     .3     .2     .1
K              1                                   1
K1                INFLOW HYDROGRAPH - RESERVOIR # 2 SUBAREA
M      1      1    .91           1.07
P           22.5    113    123    132    142
T                                                  1    .05
W   2.11    .45
X   -1.5   -.05      2
K      1      2                                   1
K1                RESERVOIR ROUTING - RESERVOIR # 2
Y                           1
Y1     1                                        10.7
$A     0    1.3    4.8
$E 805.3    830    840
$$   830   20.5    2.7    1.5
$D   834    2.7    1.5    250
K      1      3                                   1
K1                ROUTING THRU REACH 2 - 3
Y                           1
Y1     1
Y6    .1    .07     .1    760    820    900    .05
Y7     0    820     80    800    170    780    310    760    320    760
Y7   420    780    590    800    780    820
K              4                                   1
K1                INFLOW HYDROGRAPH - LONG RUN RESERVOIR # 1 SUBAREA
M      1      1    .16           1.07
P           22.5    113    123    132    142
T                                                  1    .05
W   1.27    .45
X   -1.5   -.05      2
K      2      5                                   1
K1                COMBINE HYDROGRAPHS AT RESERVOIR # 1
K      1      6                                   1
K1                RESERVOIR ROUTING - THRU LONG RUN RESERVOIR # 1
Y                           1
Y1     1                                        61.3     -1
Y4   755  755.5    756  756.5    757    758  758.5    759  759.5    760
Y5     0     34     96    176    272    499    670   1071   1696   2477
$A     0    3.4    5.5    9.5
$E 700.9    755    760    780
$$   755
$D   758
K     99
```

1 PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

```
RUNOFF HYDROGRAPH AT          1
ROUTE HYDROGRAPH TO           2
ROUTE HYDROGRAPH TO           3
RUNOFF HYDROGRAPH AT          4
COMBINE  2 HYDROGRAPHS AT     5
ROUTE HYDROGRAPH TO           6
END OF NETWORK
```

****

LONG RUN RESERVOIR NO. 1 DAM **** LONG RUN
FRANKLIN TWP., CARBON COUNTY, PA.
NDI # PA-00882 PA DER # 13-4

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	-4	0
			JOPER	NWT	LRCPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1
RTIOS= 1.00 .85 .70 .60 .50 .40 .30 .20 .10

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - RESERVOIR # 2 SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.91	0.00	1.07	0.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.50	113.00	123.00	132.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 2.11 CP= .45 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 76 END-OF-PERIOD ORDINATES, LAG= 2.11 HOURS, CP= .45 VOL= 1.00

4.	17.	34.	55.	77.	98.	114.	124.	127.	122.
113.	105.	98.	91.	84.	78.	72.	67.	62.	58.
54.	50.	46.	43.	40.	37.	34.	32.	30.	27.
25.	24.	22.	20.	19.	18.	16.	15.	14.	13.
12.	11.	10.	10.	9.	8.	8.	7.	7.	6.
6.	5.	5.	5.	4.	4.	4.	3.	3.	3.
3.	3.	2.	2.	2.	2.	2.	2.	1.	1.
1.	1.	1.	1.	1.	1.				

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

SUM 23.56 23.16 2.40 5445CS.
(649.74 638.28 61.44 1542.08)

HYDROGRAPH ROUTING

RESERVOIR ROUTING - RESERVOIR # 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	11.	0

SURFACE AREA=	0.	1.	5.
CAPACITY=	0.	11.	39.
ELEVATION=	805.	830.	840.

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
830.0	20.5	2.7	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
834.0	2.7	1.5	250.

PEAK OUTFLOW IS 1811. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 1540. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 1268. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 1087. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 906. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 725. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 543. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 361. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 180. AT TIME 42.00 HOURS

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HYDROGRAPH ROUTING

ROUTING THRU REACH 2 - 3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	1	0	0

HYDROGRAPH ROUTING

ROUTING THRU REACH 2 - 3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0700	.1000	760.0	820.0	900.	.05000

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 820.00 80.00 800.00 170.00 780.00 310.00 760.00 320.00 760.00
420.00 780.00 590.00 800.00 780.00 820.00

STORAGE	0.00	1.89	6.25	13.08	22.39	34.17	48.42	65.19	84.62	106.74
	131.53	159.01	189.16	221.99	257.58	295.96	337.11	381.05	427.77	477.27
OUTFLOW	0.00	664.50	3307.81	8876.28	18182.14	31956.26	50873.56	79547.44	116762.46	161009.08
	212647.93	272019.15	339454.01	415225.29	499644.67	593170.87	696135.80	808866.98	931687.43	1064915.68
STAGE	760.00	763.16	766.32	769.47	772.63	775.79	778.95	782.11	785.26	788.42
	791.58	794.74	797.89	801.05	804.21	807.37	810.53	813.68	816.84	820.00
FLOW	0.00	664.50	3307.81	8876.28	18182.14	31956.26	50873.56	79547.44	116762.46	161009.08
	212647.93	272019.15	339454.01	415225.29	499644.67	593170.87	696135.80	808866.98	931687.43	1064915.68

MAXIMUM STAGE IS 764.5

MAXIMUM STAGE IS 764.2

MAXIMUM STAGE IS 763.9

MAXIMUM STAGE IS 763.7

MAXIMUM STAGE IS 763.4

MAXIMUM STAGE IS 763.2

MAXIMUM STAGE IS 762.6

MAXIMUM STAGE IS 761.7

MAXIMUM STAGE IS 760.9

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MAXIMUM STAGE IS 760.9

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SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - LONG RUN RESERVOIR # 1 SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.16	0.00	1.07	0.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.50	113.00	123.00	132.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 1.27 CP= .45 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 46 END-OF-PERIOD ORDINATES, LAG= 1.28 HOURS, CP= .45 VOL= 1.00

3.	10.	20.	29.	35.	36.	33.	29.	26.	23.
20.	18.	16.	14.	12.	11.	9.	8.	7.	6.
6.	5.	4.	4.	3.	3.	3.	2.	2.	2.
2.	1.	1.	1.	1.	1.	1.	1.	1.	1.
0.	0.	0.	0.	0.	0.				

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	25.56	23.16	2.40	9681.
										(649.)	(588.)	(61.)	(274.14)

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COMBINE HYDROGRAPHS

COMBINE HYDROGRAPHS AT RESERVOIR # 1

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	2	0	0	0	0	1	0	0

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HYDROGRAPH ROUTING

HYDROGRAPH ROUTING

RESERVOIR ROUTING - THRU LONG RUN RESERVOIR # 1

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	61.	-1

STAGE	755.00	755.50	756.00	756.50	757.00	758.00	758.50	759.00	759.50	760.00
FLOW	0.00	34.00	96.00	176.00	272.00	499.00	670.00	1071.00	1696.00	2477.00

SURFACE AREA=	0.	3.	6.	10.
CAPACITY=	0.	61.	83.	232.
ELEVATION=	701.	755.	760.	780.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
755.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
758.0	0.0	0.0	0.

PEAK OUTFLOW IS 2185. AT TIME 41.75 HOURS

PEAK OUTFLOW IS 1857. AT TIME 41.75 HOURS

PEAK OUTFLOW IS 1528. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 1310. AT TIME 41.75 HOURS

PEAK OUTFLOW IS 1093. AT TIME 41.75 HOURS

PEAK OUTFLOW IS 873. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 651. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 430. AT TIME 42.25 HOURS

PEAK OUTFLOW IS 215. AT TIME 42.25 HOURS

1

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 .85	RATIO 3 .70	RATIO 4 .60	RATIO 5 .50	RATIO 6 .40	RATIO 7 .30	RATIO 8 .20	RATIO 9 .10
HYDROGRAPH AT	1	.91	1	1811.	1540.	1268.	1087.	906.	725.	543.	362.	181.
	(	2.36)	(	51.29)(	43.60)(	35.90)(	30.78)(	25.65)(	20.52)(	15.39)(	10.26)(	5.13)
ROUTED TO	2	.91	1	1811.	1540.	1268.	1087.	906.	725.	543.	361.	180.
	(	2.36)	(	51.29)(	43.60)(	35.91)(	30.79)(	25.66)(	20.53)(	15.38)(	10.22)(	5.11)
ROUTED TO	3	.91	1	1813.	1540.	1268.	1088.	908.	727.	545.	361.	180.
	(	2.36)	(	51.33)(	43.62)(	35.91)(	30.81)(	25.71)(	20.60)(	15.45)(	10.21)(	5.10)
HYDROGRAPH AT	4	.16	1	424.	360.	297.	254.	212.	169.	127.	85.	42.
	(	.41)	(	12.00)(	10.20)(	8.40)(	7.20)(	6.00)(	4.80)(	3.60)(	2.40)(	1.20)
2 COMBINED	5	1.07	1	2187.	1860.	1532.	1312.	1091.	873.	655.	434.	217.
	(	2.77)	(	61.94)(	52.66)(	43.38)(	37.14)(	30.90)(	24.73)(	18.55)(	12.28)(	6.14)
ROUTED TO	6	1.07	1	2185.	1857.	1528.	1310.	1093.	873.	651.	430.	215.
	(	2.77)	(	61.88)(	52.58)(	43.27)(	37.09)(	30.94)(	24.71)(	18.44)(	12.18)(	6.08)

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	829.99	830.00	834.00
STORAGE	11.	11.	18.
OUTFLOW	0.	0.	443.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	835.40	1.40	22.	1811.	9.75	42.00	0.00
.85	835.20	1.20	21.	1540.	8.50	42.00	0.00
.70	834.98	.98	21.	1268.	7.75	42.00	0.00
.60	834.82	.82	20.	1087.	6.50	42.00	0.00
.50	834.65	.65	20.	906.	5.75	42.00	0.00
.40	834.45	.45	19.	725.	4.25	42.00	0.00
.30	834.21	.21	19.	543.	2.75	42.00	0.00
.20	833.49	0.00	17.	361.	0.00	42.00	0.00
.10	832.20	0.00	14.	180.	0.00	42.00	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	1813.	764.5	42.00
.85	1540.	[illegible]	[illegible]

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	1813.	764.5	42.00
.85	1540.	764.2	42.00
.70	1268.	763.9	42.00
.60	1089.	763.7	42.00
.50	908.	763.4	42.00
.40	727.	763.2	42.00
.30	545.	762.6	42.00
.20	361.	761.7	42.00
.10	180.	760.9	42.00

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	754.99	755.00	768.00
	STORAGE	61.	61.	73.
	OUTFLOW	0.	0.	499.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	759.81	1.81	82.	2185.	9.75	41.75	0.00
.85	759.60	1.60	81.	1857.	9.00	41.75	0.00
.70	759.37	1.37	80.	1528.	7.75	42.00	0.00
.60	759.19	1.19	79.	1310.	7.00	41.75	0.00
.50	759.02	1.02	78.	1093.	5.75	41.75	0.00
.40	758.75	.75	77.	873.	4.50	42.00	0.00
.30	758.45	.45	75.	651.	3.00	42.00	0.00
.20	757.70	0.00	72.	430.	0.00	42.25	0.00
.10	756.70	0.00	68.	215.	0.00	42.25	0.00

EOI ENCOUNTERED.

N>

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**********************************
   1          A1                 LONG RUN RESERVOIR NO. 1 DAM    ****    LONG RUN
   2          A2                 FRANKLIN TWP., CARBON COUNTY, PA.
   3          A3                 NDI # PA-00882      PA DER # 13-4
   4          B    300      0      15      0      0      0      0      0     -1      0
   5          B1     5
   6          J      4      1       1
   7          J1    .5
   8          K             1                                      1
   9          K1                 INFLOW HYDROGRAPH - RESERVOIR # 2 SUBAREA
  10          M      1      1     .91           1.07                             1
  11          P           22.5     113     123     132     142
  12          T                                                    1     .05
  13          W   2.11     .45
  14          X   -1.5    -.05       2
  15          K      1      2                                      1
  16          K1                 RESERVOIR ROUTING - RESERVOIR # 2
  17          Y                              1       1
  18          Y1     1                                           10.7
  19          $A     0    1.3     4.8
  20          $E 805.3    830     840
  21          $$   830   20.5     2.7     1.5
  22          $D   834    2.7     1.5     250
  23          $B    50      1     820     .25     830   834.5
  24          $B    50      1     820      .5     830   834.5
  25          $B    50      1     820       1     830   834.5
  26          $B    50      1     820       2     830   834.5
  27          K      1      3                                      1
  28          K1                 ROUTING THRU REACH 2 - 3
  29          Y                              1       1
  30          Y1     1
  31          Y6    .1    .07      .1     760     820     900     .05
  32          Y7     0    820      80     800     170     780     310     760     320     760
  33          Y7   420    780     590     800     780     820
  34          K             4                                      1
  35          K1                 INFLOW HYDROGRAPH - LONG RUN RESERVOIR # 1 SUBAREA
  36          M      1      1     .16           1.07                             1
  37          P           22.5     113     123     132     142
  38          T                                                    1     .05
  39          W   1.27     .45
  40          X   -1.5    -.05       2
  41          K      2      5                                      1
  42          K1                 COMBINE HYDROGRAPHS AT RESERVOIR # 1
  43          K      1      6                                      1
  44          K1                 RESERVOIR ROUTING - THRU LONG RUN RESERVOIR # 1
  45          Y                              1       1
  46          Y1     1                                           61.3      -1
  47          Y4   755   755.5     756   756.5     757     758   758.5     759   759.5     760
  48          Y5     0     34      96     176     272     499     670    1071    1696    2477
  49          $A     0    3.4     5.5     9.5
  50          $E 700.9    755     760     780
1 51          $$   755
  52          $D   758
  53          K     99
1                          PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                                RUNOFF HYDROGRAPH AT          1
                                ROUTE HYDROGRAPH TO           2
                                ROUTE HYDROGRAPH TO           3
                                RUNOFF HYDROGRAPH AT          4
                                COMBINE  2 HYDROGRAPHS AT     5
                                ROUTE HYDROGRAPH TO           6
                                END OF [illegible]
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LONG RUN RESERVOIR NO. 1 DAM **** LONG RUN
FRANKLIN TWP., CARBON COUNTY, PA.
NDI # PA-00832 PA DER # 13-4

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	-4	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 4 NRTIO= 1 LRTIO= 1
RTIOS= .50

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SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - RESERVOIR # 2 SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.91	0.00	1.07	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.50	113.00	123.00	132.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 2.11 CP= .45 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 76 END-OF-PERIOD ORDINATES, LAG= 2.11 HOURS, CP= .45 VOL= 1.00

4.	17.	34.	55.	77.	98.	114.	124.	127.	122.
113.	105.	98.	91.	84.	78.	72.	67.	62.	58.
54.	50.	46.	43.	40.	37.	34.	32.	30.	27.
25.	24.	22.	20.	19.	18.	16.	15.	14.	13.
12.	11.	10.	10.	9.	8.	8.	7.	7.	6.
6.	5.	5.	5.	4.	4.	4.	3.	3.	3.
3.	3.	2.	2.	2.	2.	2.	2.	1.	1.
1.	1.	1.	1.	1.	1.				

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	25.56	23.16	2.40	54458.
										(649.)(588.)(61.)(1542.08)			

RESERVOIR ROUTING - RESERVOIR # 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	11.	0

SURFACE AREA=	0.	1.	5.
CAPACITY=	0.	11.	39.
ELEVATION=	805.	830.	840.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
830.0	20.5	2.7	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
834.0	2.7	1.5	250.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
50.	1.00	820.00	.25	830.00	834.50

BEGIN DAM FAILURE AT 41.00 HOURS

PEAK OUTFLOW IS 1802. AT TIME 41.13 HOURS

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
50.	1.00	820.00	.50	830.00	834.50

BEGIN DAM FAILURE AT 41.00 HOURS

PEAK OUTFLOW IS 1343. AT TIME 41.20 HOURS

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
50.	1.00	820.00	1.00	830.00	834.50

BEGIN DAM FAILURE AT 41.00 HOURS

PEAK OUTFLOW IS 1116. AT TIME 41.33 HOURS

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
50.	1.00	820.00	2.00	830.00	834.50

BEGIN DAM FAILURE AT 41.00 HOURS

PEAK OUTFLOW IS 1025. AT TIME 41.75 HOURS

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTING THRU REACH 2 - 3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0700	.1000	760.0	820.0	900.	.05000

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 820.00 80.00 800.00 170.00 780.00 310.00 760.00 320.00 760.00
420.00 780.00 590.00 800.00 780.00 820.00

STORAGE	0.00	1.89	6.25	13.08	22.39	34.17	48.42	65.19	84.62	106.74
	131.53	159.01	189.16	221.99	257.58	295.96	337.11	381.05	427.77	477.27
OUTFLOW	0.00	664.50	3307.81	8876.28	18182.14	31956.26	50873.56	79547.44	116762.46	161039.08
	212647.93	272019.15	339454.01	415225.29	499644.67	593170.87	696135.80	808866.98	931687.43	1064915.68
STAGE	760.00	763.16	766.32	769.47	772.63	775.79	778.95	782.11	785.26	788.42
	791.58	794.74	797.89	801.05	804.21	807.37	810.53	813.68	816.84	820.00
FLOW	0.00	664.50	3307.81	8876.28	18182.14	31956.26	50873.56	79547.44	116762.46	161039.08
	212647.93	272019.15	339454.01	415225.29	499644.67	593170.87	696135.80	808866.98	931687.43	1064915.68

MAXIMUM STAGE IS 764.0

MAXIMUM STAGE IS 763.9

MAXIMUM STAGE IS 763.7

MAXIMUM STAGE IS 763.6

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - LONG RUN RESERVOIR # 1 SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	0	0	0	0	0	1	0	0

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - LONG RUN RESERVOIR # 1 SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.16	0.00	1.07	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.50	113.00	123.00	132.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 1.27 CP= .45 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 46 END-OF-PERIOD ORDINATES, LAG= 1.28 HOURS, CP= .45 VOL= 1.00

3.	10.	20.	29.	35.	36.	33.	29.	26.	23.
20.	18.	16.	14.	12.	11.	9.	8.	7.	6.
6.	5.	4.	4.	3.	3.	3.	2.	2.	2.
2.	1.	1.	1.	1.	1.	1.	1.	1.	1.
0.	0.	0.	0.	0.	0.				

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	25.56	23.16	2.40	9681.
										(649.)(588.)(61.)(274.14)			

********** ********** ********** ********** **********

COMBINE HYDROGRAPHS

COMBINE HYDROGRAPHS AT RESERVOIR # 1

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	2	0	0	0	0	1	0	0

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

RESERVOIR ROUTING - THRU LONG RUN RESERVOIR # 1

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

RESERVOIR ROUTING - THRU LONG RUN RESERVOIR # 1

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	61.	-1

STAGE	755.00	755.50	756.00	756.50	757.00	758.00	758.50	759.00	759.50	760.00
FLOW	0.00	34.00	96.00	176.00	272.00	499.00	670.00	1071.00	1696.00	2477.00
SURFACE AREA=	0.	3.	6.	10.						
CAPACITY=	0.	61.	83.	232.						
ELEVATION=	701.	755.	760.	780.						

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
755.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
758.0	0.0	0.0	0.

PEAK OUTFLOW IS 1386. AT TIME 41.25 HOURS

PEAK OUTFLOW IS 1485. AT TIME 41.50 HOURS

PEAK OUTFLOW IS 1347. AT TIME 41.50 HOURS

PEAK OUTFLOW IS 1221. AT TIME 41.75 HOURS

********** ********** ********** ********** **********

1

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO APPLIED TO FLOWS 1
				.50

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .50
HYDROGRAPH AT	1	.91	1	906.
		(2.36)		(25.65)(
			2	906.
				(25.65)(
			3	906.
				(25.65)(
			4	906.
				(25.65)(
ROUTED TO	2	.91	1	1430.
		(2.36)		(40.50)(
			2	1318.
				(37.33)(
			3	1103.
				(31.25)(
			4	1025.
				(29.03)(
ROUTED TO	3	.91	1	1341.
		(2.36)		(37.99)(
			2	1245.
				(35.25)(
			3	1134.
				(32.10)(
			4	1025.
				(29.02)(
HYDROGRAPH AT	4	.16	1	212.
		(.41)		(6.00)(
			2	212.
				(6.00)(
			3	212.
				(6.00)(
			4	212.
				(6.00)(
2 COMBINED	5	1.07	1	1548.
		(2.77)		(43.83)(
			2	1451.
				(41.10)(
			3	1332.
				(37.72)(
			4	1215.
				(34.42)(
ROUTED TO	6	1.07	1	1386.
		(2.77)		(39.23)(
			2	1485.
				(42.06)(
			3	1347.
				(38.13)(
			4	1221.
				(34.58)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	830.00	830.00	834.00
STORAGE	11.	11.	18.
OUTFLOW	0.	0.	443.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	834.51	.51	19.	1802.	1.31	41.13	41.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	830.00	830.00	834.00
STORAGE	11.	11.	18.
OUTFLOW	0.	0.	443.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	834.51	.51	19.	1343.	1.34	41.20	41.00

PLAN 3 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	830.00	830.00	834.00
STORAGE	11.	11.	18.
OUTFLOW	0.	0.	443.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	834.51	.51	19.	1116.	1.40	41.33	41.00

PLAN 4 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	830.00	830.00	834.00
STORAGE	11.	11.	18.
OUTFLOW	0.	0.	443.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	834.51	.51	19.	1025.	1.54	41.75	41.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	1341.	764.0	41.25

PLAN 2 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	1245.	763.9	41.25

PLAN 3 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	1134.	763.7	41.50

PLAN 4 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	1025.	763.6	41.75

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	754.99	755.00	758.00
STORAGE	61.	61.	73.
OUTFLOW	0.	0.	499.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	759.25	1.25	79.	1386.	5.75	41.25	0.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	754.99	755.00	758.00
STORAGE	61.	61.	73.
OUTFLOW	0.	0.	499.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	759.33	1.33	80.	1485.	5.75	41.50	0.00

PLAN 3 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	754.99	755.00	758.00
STORAGE	61.	61.	73.
OUTFLOW	0.	0.	499.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	759.22	1.22	79.	1347.	5.75	41.50	0.00

PMF	W.S.ELEV	OVER DAM	[illegible]	[illegible]	[illegible]	[illegible]
.50	759.22	1.22	79.	1347.	5.75	41.50	0.00

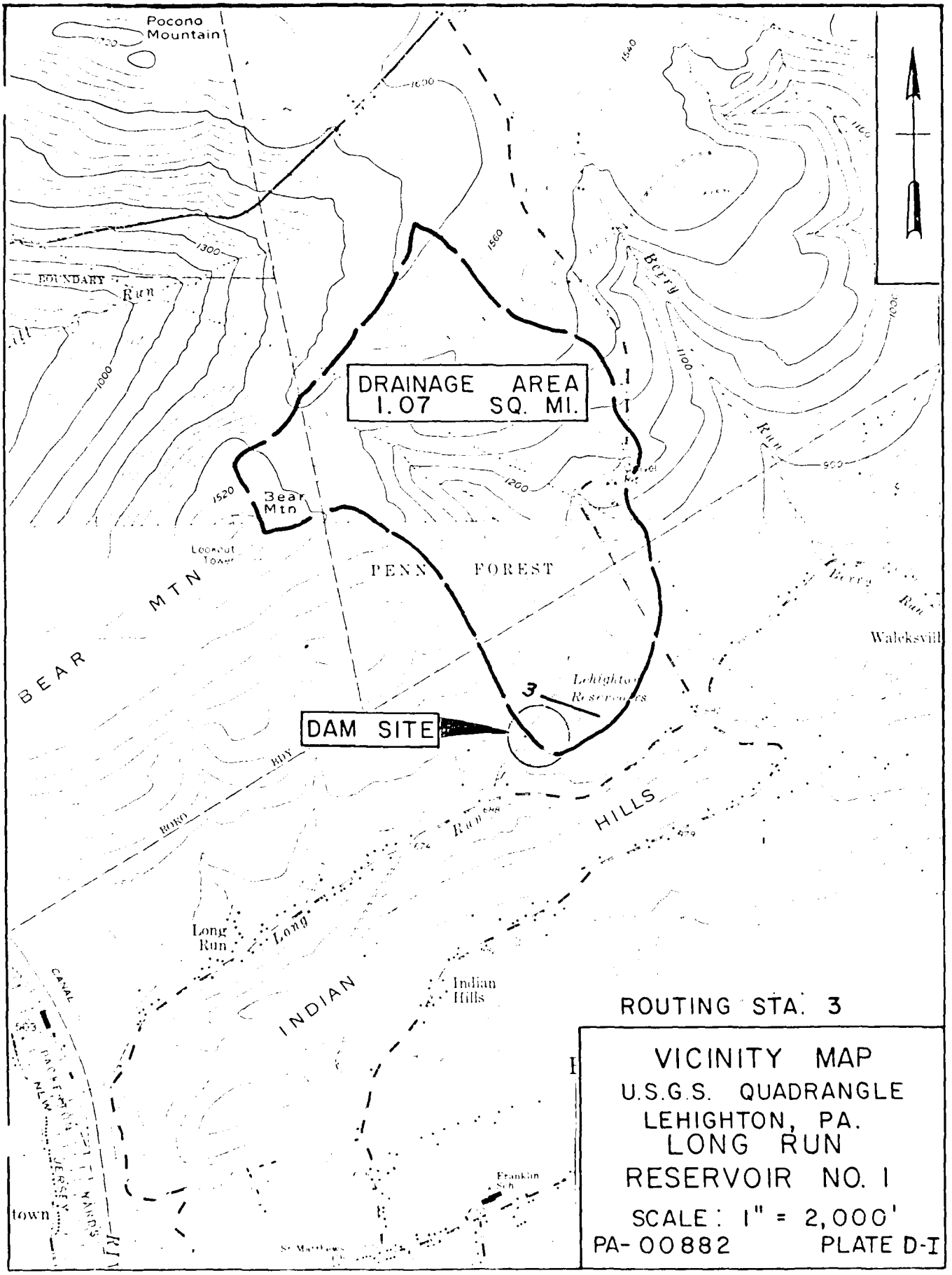
PLAN 4 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	754.99	755.00	758.00
STORAGE	61.	61.	73.
OUTFLOW	0.	0.	499.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	759.12	1.12	79.	1221.	5.75	41.75	0.00

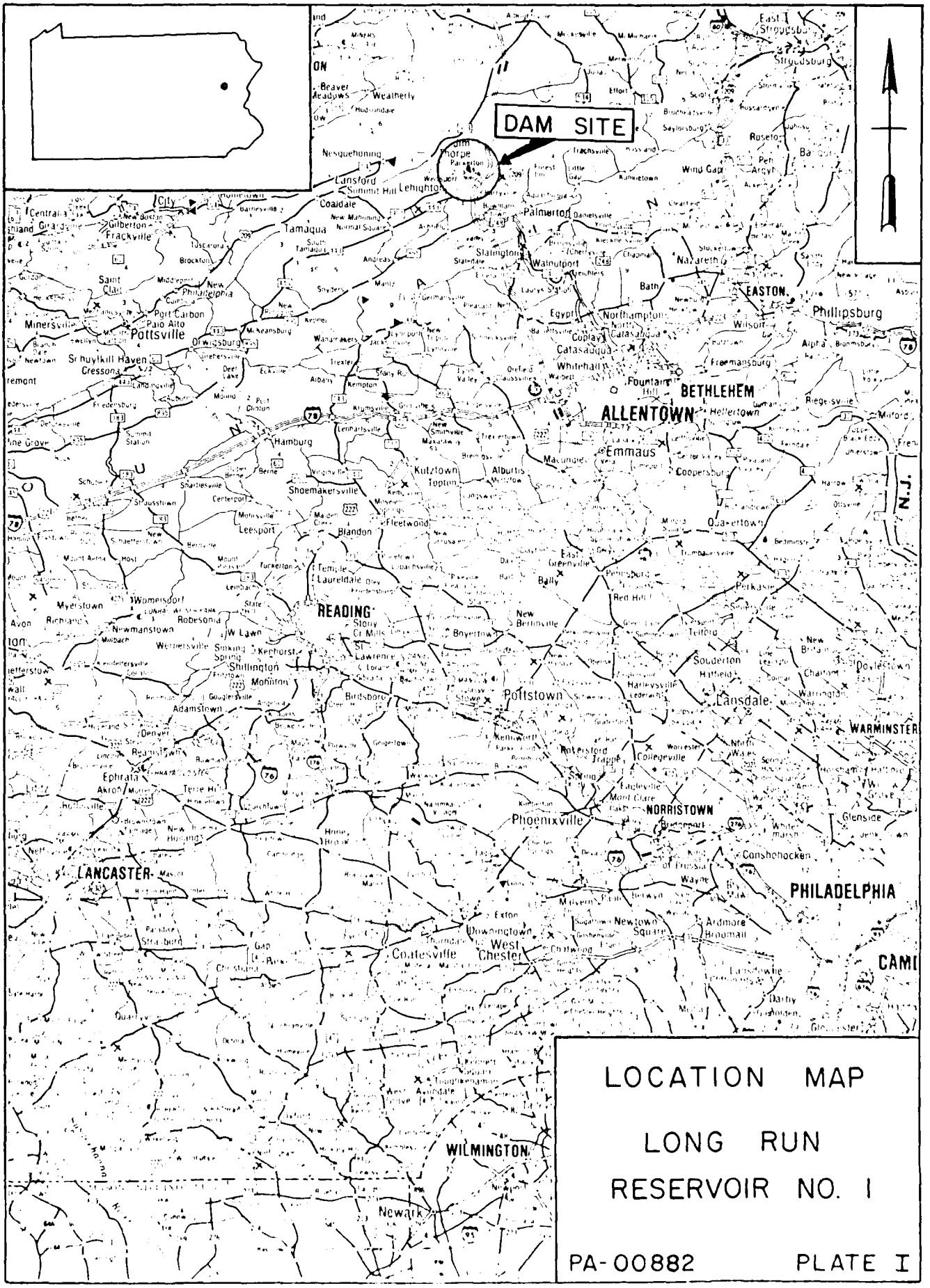
EOI ENCOUNTERED.

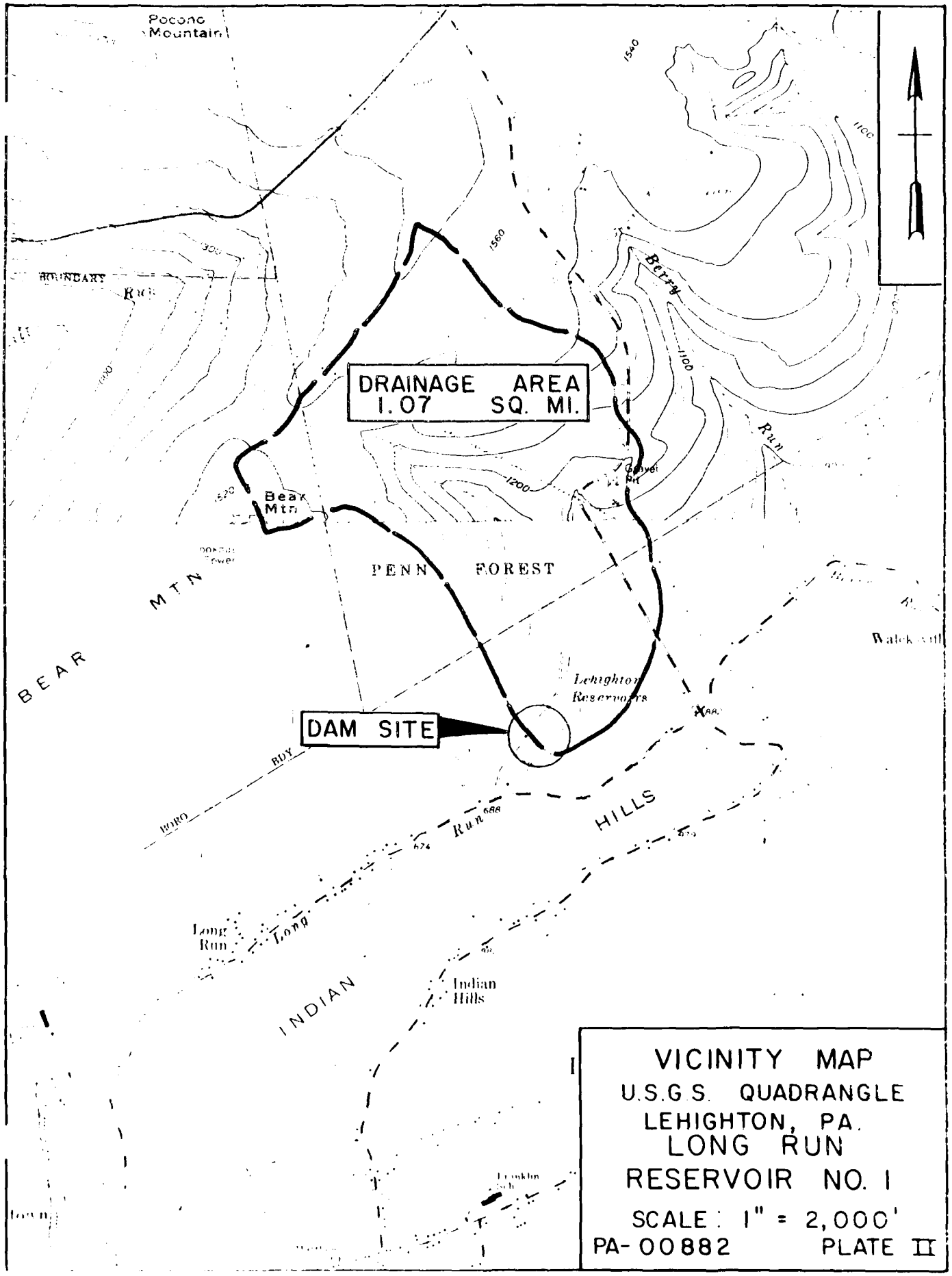
N>


Pocono Mountain
BOUNDARY
Run
DRAINAGE AREA
1.07 SQ. MI.
Bear Mtn
Lookout Tower
PENN FOREST
BEAR MTN
Berry Run
Walcksvill
Lehighton Reservoirs
3
DAM SITE
BDY
BORO
Long Run
HILLS
INDIAN
Indian Hills
CANAL
Franklin Sch
town
ROUTING STA. 3
VICINITY MAP
U.S.G.S. QUADRANGLE
LEHIGHTON, PA.
LONG RUN
RESERVOIR NO. 1
SCALE: 1" = 2,000'
PA-00882
PLATE D-I

APPENDIX E

PLATES


DAM SITE
Jim Thorpe
Nesquehoning
Lansford
Summit Hill
Lehighton
Coaldale
Tamaqua
Palmerton
Wind Gap
Stroudsburg
East Stroudsburg
Saylorsburg
Roseto
Bangor
Wind Gap
Pen Argyl
Slatington
Walnutport
Nazareth
Bath
EASTON
Phillipsburg
Wilson
Northampton
Egypt
Coplay
Catasauqua
Whitehall
Fountain Hill
Freemansburg
BETHLEHEM
ALLENTOWN
Hellertown
Riegelsville
Milford
Emmaus
Macungie
Coopersburg
Quakertown
Kutztown
Topton
Alburtis
Hamburg
Shoemakersville
Leesport
Blandon
Fleetwood
Temple
Laureldale
Bally
Pennsburg
Red Hill
Perkasie
READING
Womelsdorf
Robesonia
Newmanstown
W Lawn
Shillington
Mohnton
Kenhorst
Lawrenceville
Boyertown
New Berlinville
Souderton
Harleysville
Telford
Doylestown
Adamstown
Birdsboro
Pottstown
Lansdale
WARMINSTER
Ephrata
Akron
Terre Hill
Robesonia
Collegeville
NORRISTOWN
Phoenixville
Glenside
Conshohocken
LANCASTER
PHILADELPHIA
Strasburg
Gap
Coatesville
Downingtown
West Chester
Newtown Square
Ardmore
Broomall
Lansdowne
Darby
Glenolden
WILMINGTON
Newark
Pottsville
Port Carbon
Palo Alto
Minersville
Saint Clair
Frackville
Gilberton
Mahanoy City
Shenandoah
Ashland
Girardville
Centralia
Mount Carmel
Shamokin
Schuylkill Haven
Cressona
Tremont
Pine Grove
Summit Station
Schaefferstown
Myerstown
Richland
Avon
Jefferson
Wall
Denver
Reamstown
Ephrata
Akron
Terre Hill
Lititz
Manheim
Lancaster
Strasburg
Quarryville
Oxford
Kennett Square
Avondale
Toughkenamon
Chadds Ford
Media
Swarthmore
Darby
Glenolden
Folcroft
Sharon Hill
Yeadon
Lansdowne
Upper Darby
Drexel Hill
Havertown
Broomall
Ardmore
Bryn Mawr
Haverford
Wayne
Radnor
Villanova
Berwyn
Paoli
Malvern
Exton
Newtown Square
Chadds Ford
Kennett Square
Avondale
Toughkenamon
Oxford
Quarryville
Strasburg
Gap
Coatesville
Downingtown
West Chester
Phoenixville
Norristown
Conshohocken
Glenside
Jenkintown
Abington
Willow Grove
Hatboro
Horsham
Warminster
Doylestown
New Britain
Chalfont
Warrington
Perkasie
Quakertown
Coopersburg
Macungie
Emmaus
Allentown
Bethlehem
Easton
Phillipsburg
Riegelsville
Milford
Frenchtown
Lambertville
Stockton
Flemington
Ringoes
Sergeantsville
Titusville
Pennington
Hopewell
Princeton
Trenton
Bordentown
Burlington
Mount Holly
Moorestown
Cherry Hill
Haddonfield
Camden
Gloucester City
Woodbury
Glassboro
Vineland
Millville
Bridgeton
Salem
Penns Grove
Carneys Point
Pennsville
Swedesboro
Woodstown
Pilesgrove
Elmer
Newfield
Franklinville
Glassboro
Mullica Hill
Harrisonville
Swedesboro
Woodbury
Gloucester City
Camden
Haddonfield
Cherry Hill
Moorestown
Mount Holly
Burlington
Bordentown
Trenton
Princeton
Hopewell
Pennington
Titusville
Sergeantsville
Ringoes
Flemington
Stockton
Lambertville
Frenchtown
Milford
Riegelsville
Phillipsburg
Easton
Bethlehem
Allentown
Emmaus
Macungie
Coopersburg
Quakertown
Perkasie
Doylestown
New Britain
Chalfont
Warrington
Warminster
Jenkintown
Abington
Willow Grove
Hatboro
Horsham



VICINITY MAP

U.S.G.S. QUADRANGLE

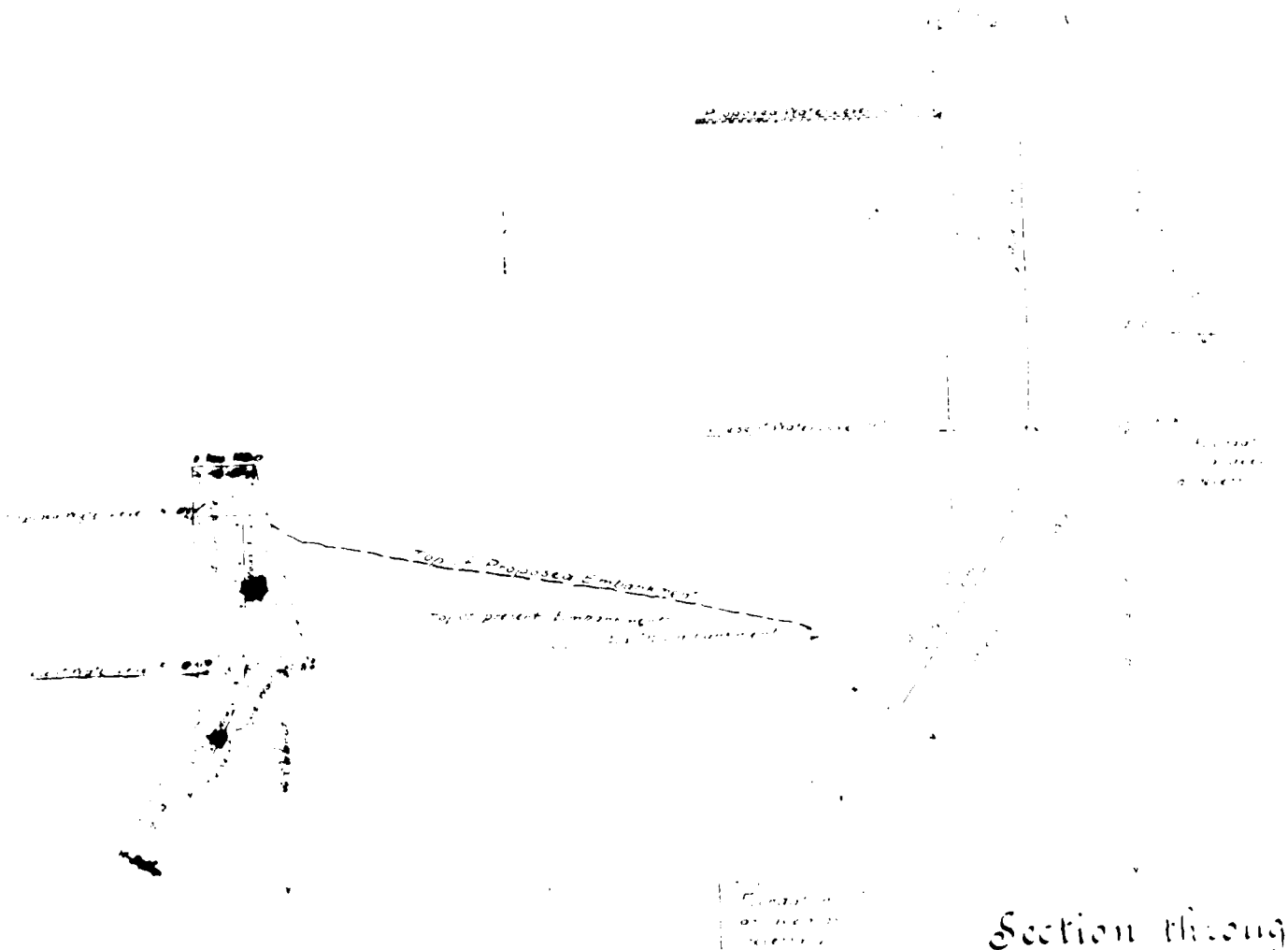
LEHIGHTON, PA.

LONG RUN

RESERVOIR NO. 1

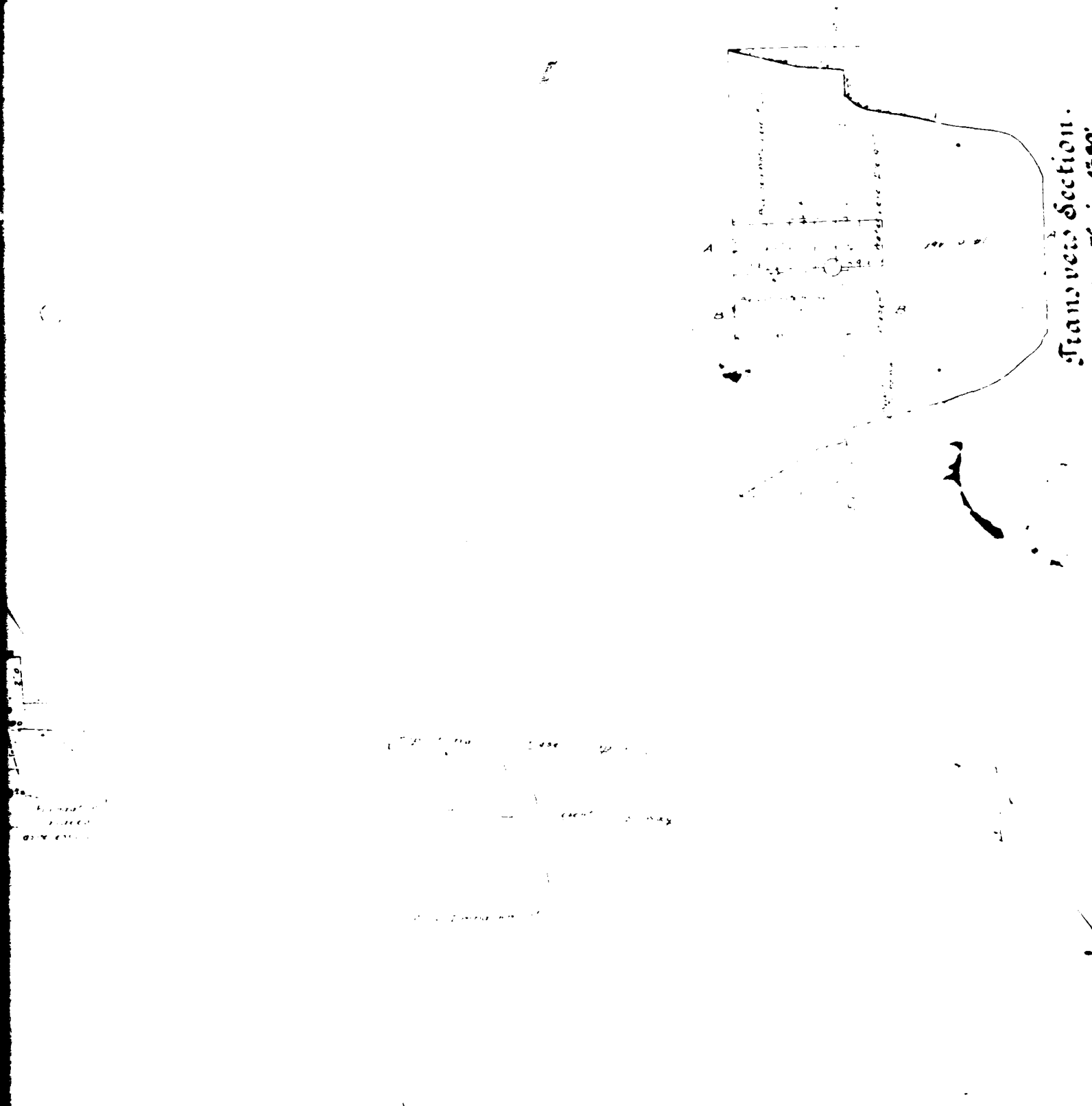
SCALE: 1" = 2,000'

PA-00882 PLATE II



Section on B-B
Scale ¼" = 1'

Section through Spill
Scale ½" = 1'



through Spillway A-A
ale 1/2"=1'

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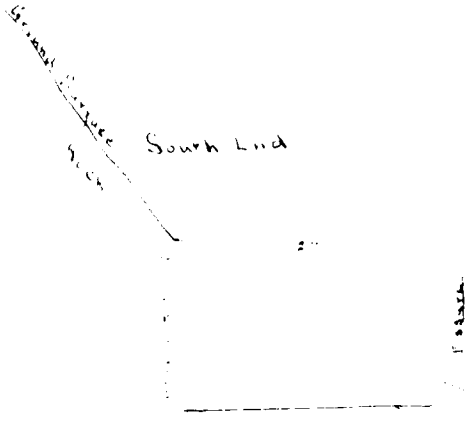
PLATE III


South End

LEHIGHTON WATER SUPPLY COMPANY, LEHIGHTON PA.

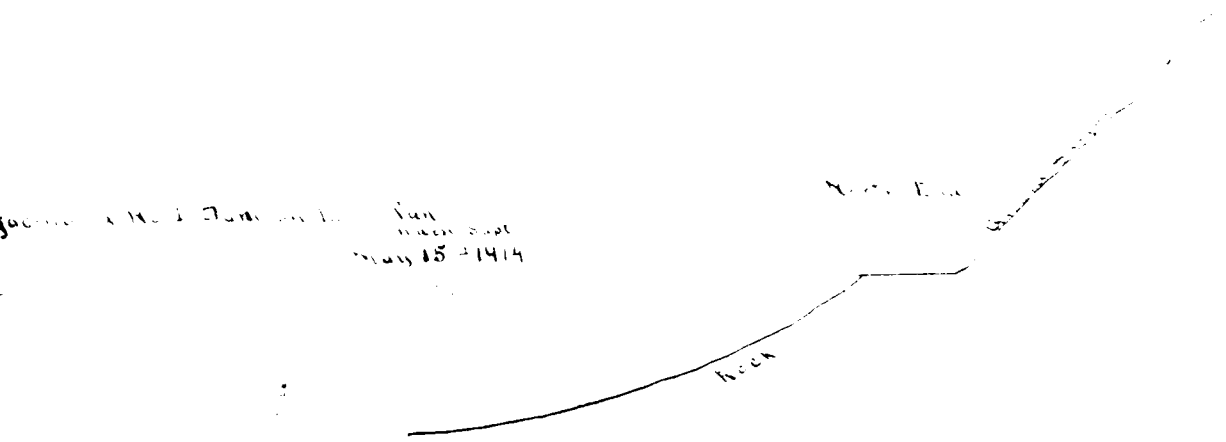


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PLATE IV

APPENDIX F

GEOLOGIC REPORT

GEOLOGIC REPORT

BEDROCK - DAM AND RESERVOIR

This area overlies the Long Run member of the Catskill Formation which consists of alternating gray and red sandstone and red siltstone and shale, in fining upward cycles.

STRUCTURE

The structural grain in the area trends about N70°E. Fracturing and jointing are well developed and closely spaced in the siltstones and shales. The dip ranges from 45° to vertical.

OVERBURDEN

The overburden in the area south of the dam consists of alluvium originating from Long Run. The remaining area is most probably covered with residual soil originating from the parent bedrock.

AQUIFER CHARACTERISTICS

The Catskill Formation is a fair to good aquifer. The interstitial porosity is low in the coarser rocks. The possibility of subsurface seepage exists, but the extent depends on the localized lithology.

DISCUSSION

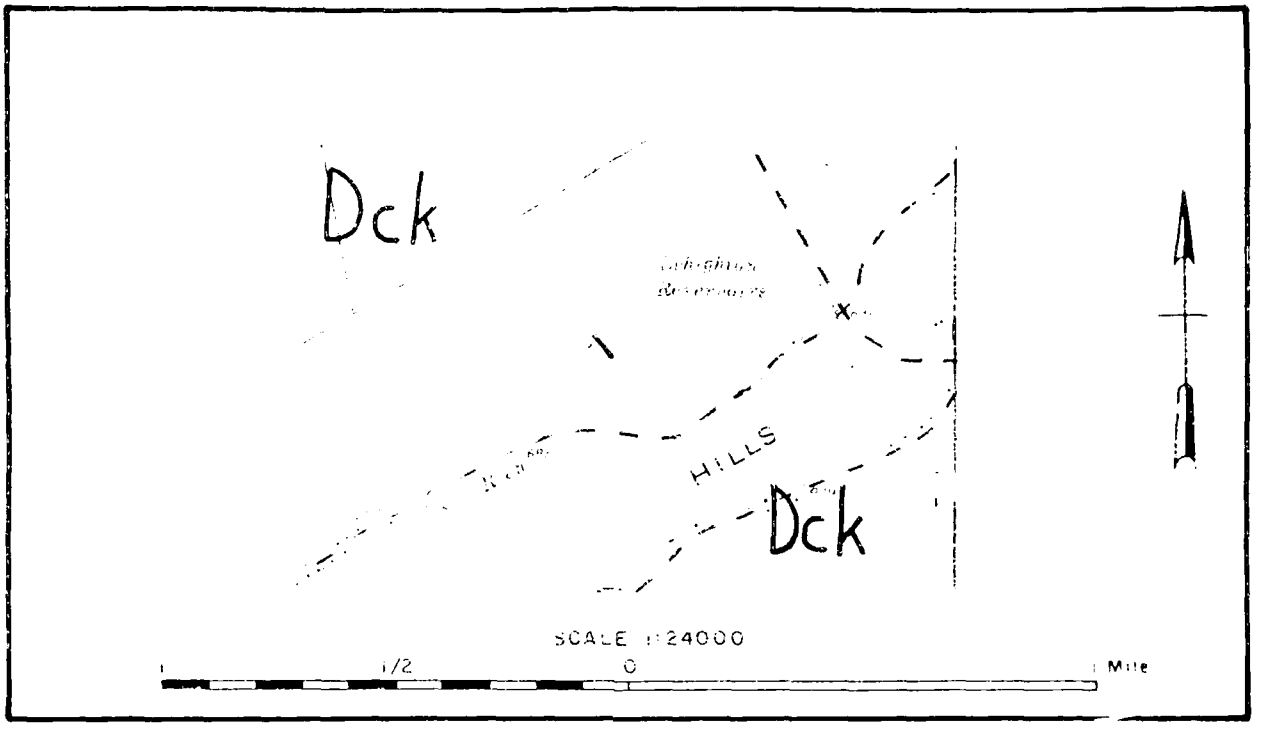
The Catskill Formation provides a good quality foundation for structures. Shales and siltstones are subject to weathering when exposed to water. Construction data indicates that the original dam was placed on a gravel and sand layer above the rock formation. Considerable leakage occurred. A cutoff wall was constructed at the toe and in the sidehills to form a watertight curtain. This curtain is not totally effective as evidenced by the existing seepage downstream. The seepage is apparently through the foundation.

SOURCES OF INFORMATION

1. Epstein, J.B., et. al., 1974. Geology and Mineral Resources of the Lehighton and Palmerton Quadrangles, Carbon and Northampton Counties, Pennsylvania: Pennsylvania Geological Survey A-195cd.

2. McGlade, W.G., et. al., 1972. Engineering Characteristics of the Rocks of Pennsylvania: Pennsylvania Geological Survey EG-1.

GEOLOGIC MAP - LONG RUN RESERVOIR NO. 1



LEGEND

Dck — Catskill Formation